ECONOMIC INVESTIGATION AND ANALYSIS OF THE CONNECTICUT RIVER ABOVE HARTFORD, CONNECTICUT

Submitted to:

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EXECUTIVE SUMMARY

This report is the result of an economic investigation and analysis of a proposed extension of navigation on the Connecticut River north of Hartford, CT to Holyoke, MA for 32.5 miles.

The primary study region of northern Hartford County in Connecticut and Hampden and Hampshire counties in Massachusetts consists of commercial and light industrial usage that is in the process of shifting to a service economy. The potential need for using large, efficient bargeloads of bulk and neobulk commodities is very limited.

Ample pipeline, rail, and truck services exist in the study area for the types of commodities that will be moved in the next 50 years.

The study identified 605 shippers and receivers in the area as potential users of barge transportation. A total of 24 movements were identified that were susceptible to a shift from a land mode to the river. These totaled 1,005,837 tons in 1984 for a saving of $3,146,390.

After projecting this traffic into the future, until 2040, and discounting the savings back to 1990 at 8.875 percent, the present value of the incremental savings over the project life was calculated to total $54,861,096. The annual benefits of the project total $4,678,498.

INTRODUCTION

The U.S. Army Corps of Engineers (USACE) is studying the feasibility of extending navigation on the Connecticut river beyond its current terminus at Hartford, Connecticut to Holyoke, Massachusetts--a distance of 32.5 miles. The USACE conducted a competitive procurement and selected Bucher and Cope, Inc., (B&C) and its two subcontractors, Temple, Barker & Sloane, Inc. (TBS) and Regional Economic Models, Inc. (REMI) to conduct an economic investigation and analysis of the proposed extension of navigation. The objective of this study was to provide the economic benefit data required by the USACE as an input to its overall feasibility study.

This Report describes the results of the eight tasks completed during the Connecticut River study. The report is organized as follows, with the task numbers that were used in the Proposal and the Request for Proposal (RFP) identified:

Report Section		Task Number	
		TBS Proposal	USACE RFP
A.	Description of the Region		
	1. Primary Study Area	I-2	I.B.
	2. Transportation System	I-4	I.D.
	3. Commodity Flows	I-7	I.G.
B.	Economic Baseline		
	1. Economic and Social Statistics	I-3	I.C.
	2. Industrial Trends	I-6	I.F.
C.	Potential Users		
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D.	Transportation Rates		
	1. Waterway Rates	II-1	II.A., II.B.
	2. Alternative Modal Rates	II-2	II-C.
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E.	Potential River Traffic		
	1. User Survey	III-1	III.A.,III.B., III.C.
	2. Potential River Traffic	III-1	III.C.
	3. Projected Waterway Use	III-2	III.D.
	4. Estimated Savings	III-3	III.E.
	5. Future Development Plans	III-4	III.F.

In addition, Appendices contain detailed information about the bibliography; historical and projected economic data; the survey instruments, results, and non-respondents; and regional planner interviews.

A. DESCRIPTION OF THE REGION

This section describes the primary area under study, provides an overview of the existing elements of the region's transportation system, and presents data on recent movements of freight by each mode in that system.

A.1 PRIMARY STUDY AREA

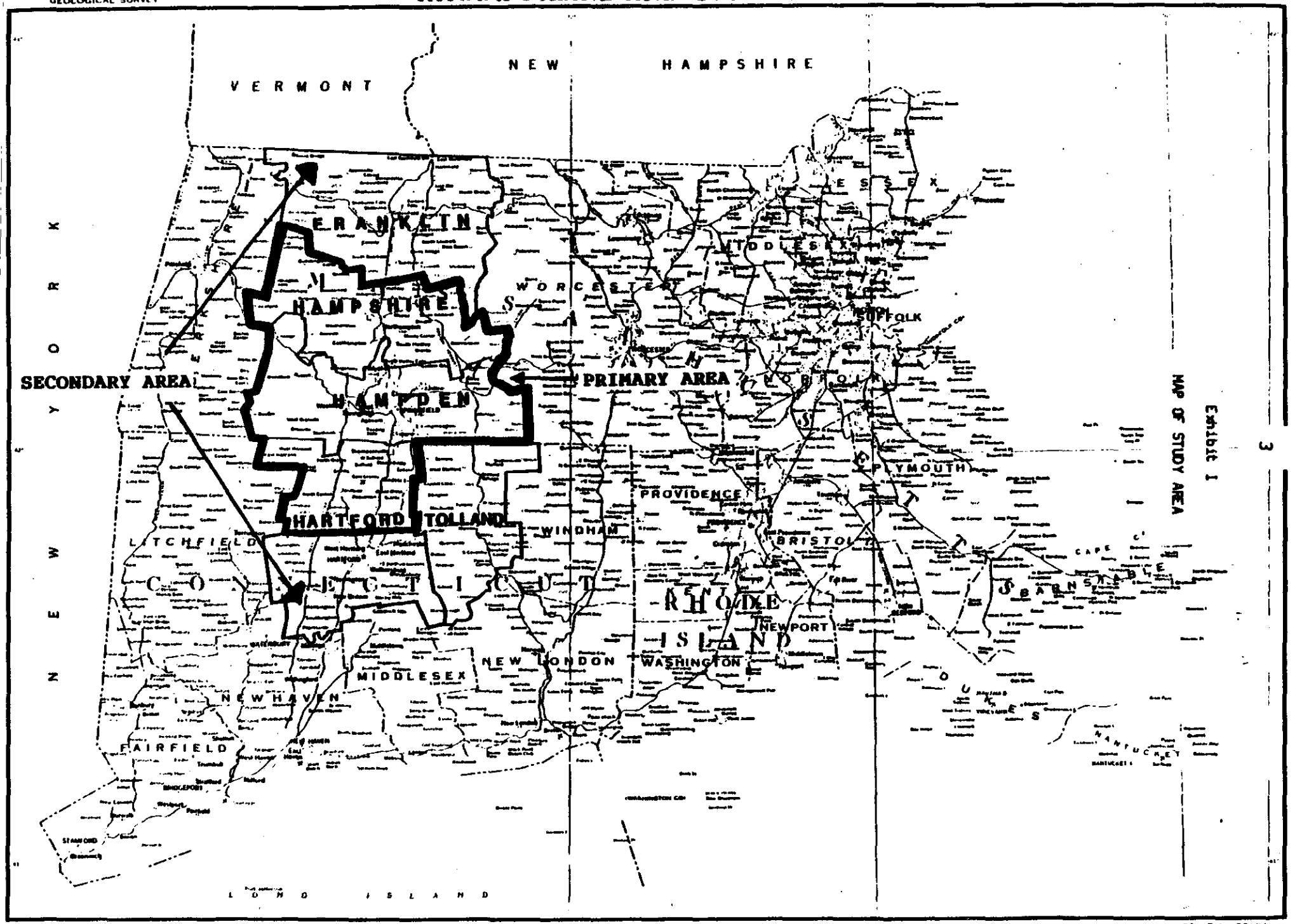
Navigation on the Connecticut River between Hartford, Connecticut and Holyoke, Massachusetts could serve the needs of shippers and consignees of bulk, neobulk, and containerized cargo who are located in Northwest Connecticut and Western Massachusetts. The principal locations of facilities that could use barge service on the river was assumed to be within 20 to 25 miles of riverfront terminals. This distance would capture all movements that would take less than 30 minutes to dray to or from the waterway by local trucks. Any longer haul by road would compete directly with truck service directly to the ports of New Haven, New York, and Boston. This range does not exclude all longer hauls to the river, but specifies that most of the movements using the river will be within the primary area that includes the northern portion of Hartford County in Connecticut and all of Hampden and Hampshire Counties in Massachusetts. This covers an area of approximately 1,516 square miles.

Secondary areas that have facilities which have traffic that could potentially move on the River include the southern portion of Hartford County and Tolland County in Connecticut, as well as Franklin County in Massachusetts. The map in Exhibit 1 highlights the primary and secondary areas. Exhibit 2 lists all of the communities included in the primary study area. Many of these places are unincorporated political entities but are listed in directories of manufacturing and service establishments. Two towns from the secondary study area--Greenfield, MA and Deerfield, MA--also were included in the study because of their close access to highway I-91 keeping them within 30 minutes of river service at Holyoke. The secondary area includes approximately 1,071 square miles.

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

STATES OF MASSACHUSETTS, RHODE ISLAND AND CONNECTICUT

MASS.—R.I.—CONN.



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MASS.—R.I.—CONN.

Exhibit 2

COMMUNITIES IN PRIMARY STUDY AREA

NORTHERN HARTFORD COUNTY, CONNECTICUT

Bloomfield	Rainbow*
Blue Hills*	Scantic*
Broad Brook*	Scitico*
Burnside*	Somers
East Granby	Somersville*
East Hartford	South Windsor
East Windsor	Southfield Acres*
Enfield	Suffield
Hartford	Thomasville*
Hamden	West Suffield*
Hazardville*	Wilson*
Melrose*	Windsor
North Somersville*	Windsor Locks
North Thompsonville*	Windsorville*
Poquonock*	

HAMPSHIRE AND HAMDEN COUNTIES, MASSACHUSETTS

Agawam	Ludlow
Amherst	Manchester*
Belchertown	Merrick*
Brightwood*	Monson
Brimfield	North Amherst*
Chester	Northampton
Chicopee	Palmer
Chicopee Falls*	Riverdale*
Cummington	Russell
Easthampton	South Hadley
East Longmeadow	South Hadley Falls*
Feeding Hills*	Southwick
Florence*	Springfield
Granby	Thorndike*
Hatfield	Three Rivers*
Haydenville*	Ware
Holyoke	West Springfield
Huntington	Wilbraham
Ingleside*	Williamsburg
Leeds*	Willmansett*
Longmeadow	Woronoco*

FRANKLIN COUNTY, MASSACHUSETTS

Greenfield	Deerfield

* = Unincorporated political entity.

A.2 TRANSPORTATION SYSTEM

A.2.1 Introduction

The study region is served by a wide range of transportation modes to move freight within the region as well as into and out of the region.

The area is served by railroads, highways, pipelines, airports, but currently is not served directly by water transportation. Due to the large size of shipments that barges can handle, the most important competing modes of freight transportation are railroad and pipeline. Trucks can compete for full loads on relatively short hauls, but it usually is a complementary mode of freight transportation that provides prior or subsequent service to or from river transportation. Airport freight shipments are generally of smaller size lots with much higher values than barge freight. They almost never compete.

Each of these modes and the services they provide to the study area are described in this section. Exhibit 3 is a map of the study area showing river, highway, railroad, pipeline, and airport locations. A large, more detailed copy of the map is found in the pocket at the end of this volume.

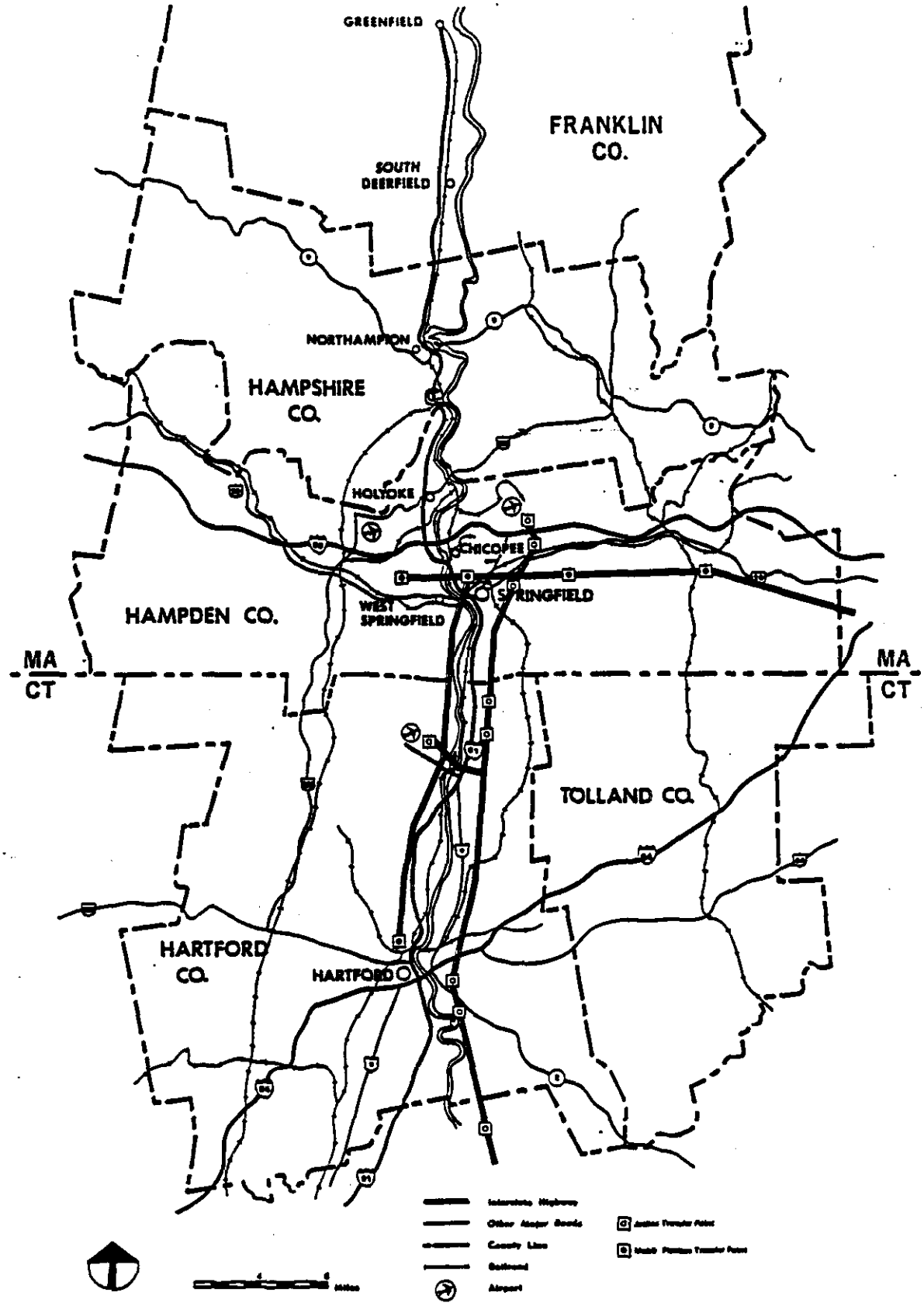
A.2.2 Railroad System

Rail service in the study area is provided by two Class I carriers (gross revenues in excess of $50 million per year) and three smaller carriers. The Consolidated Rail Corporation (Conrail) and the Boston and Maine (B&M) are the two major carriers. The smaller carriers are the Central Vermont Railroad (CV), Massachusetts Central Railroad (MCER) and the Pioneer Valley Railroad (PVRR).

A.2.2.1 Service Corridors

Conrail is the region's largest rail company. It owns and operates the east-west mainline between Selkirk, New York, and Boston. That line roughly parallels the Westfield and Chicopee Rivers. Conrail also owns and operates a spur line between Springfield and Ludlow and operates freight service on Amtrak-owned lines from Springfield south to Connecticut. In the Greater Hartford area, all freight service is provided by Conrail. Conrail's freight revenues in 1982 were $2,998,600,100.

TRANSPORTATION SERVICES IN THE STUDY AREA



CONNECTICUT RIVER VALLEY CENTRAL REGION

Bucher & Cope
26 South Prospect St.
Amherst, MA 01002

Conrail's through service is provided by two daily trains (in each direction) between Cedar Hill, CT and Selkirk, NY. Service to the southwest portion of Connecticut is provided directly from Selkirk via Beacon, NY to Danbury, CT and Bridgeport, from which local service is provided. Connecticut communities in the Hartford area are served by a Conrail local train out of Springfield.

The B&M is the second-largest railroad in the area and operates a south-north main line from Springfield, MA, north to the White River Junction, VT, following the Connecticut River. Between East Northfield, MA and White River Junction, VT, the road is used jointly with the Central Vermont Railway since some segments of the line are owned by each company. B&M also owns secondary lines from Springfield south to Cedar Hill and Berlin, CT; Chicopee to Chicopee Falls; and Holyoke to Westover Industrial Airpark in Chicopee. The B&M Berlin Route Main Line provides a link between the Connecticut River Route at White River Junction and the Canadian Pacific Railway (CP) at Wells River, VT. From White River Junction, daily through freight service is provided by B&M to Newport, VT, near the Canadian border. The B&M east-west main line is north of the study region, but is significant to the Western Massachusetts rail system as a whole. B&M's freight revenues in 1982 were $114,936,000.

The CV, an American subsidiary of Canadian National Railway (CN), offers freight service between St. Albans, VT, at the Canadian border and New London, CT, through the eastern port of the study area. Two daily freight trains serve in both directions via Palmer, Belchertown, and Amherst, MA. Freight revenues for the CV were $21,712,000 in 1982.

The MCER is an independent firm with headquarters in Barre, VT, serving 25 miles of track between Palmer and South Barre, MA. It connects with Conrail in Palmer. Revenues and other statistical informtion are not publically available.

The PVRR operation extends between Westfield, Holyoke, and Northampton, MA. In 1983, the PVRR undertook negotiations with B&M to acquire the B&M Easthampton shortline. No statistical information is available.

In 1981, Conrail initiated the transfer of several of its short lines to other carriers. In 1982 these transfers were completed. The East Longmeadow Secondary was transferred to B&M, and the Holyoke and Florence Secondaries (each about eleven miles long) were transferred to the PVRR.

A.2.2.2 Terminals

The major freight yard in the study area is in Springfield (owned by Springfield Terminal Railway Company, a subsidiary of the B&M). Additional smaller freight yards are located in Northampton, Holyoke, Westfield, Palmer, Wilbraham, and Hartford.

Rail intermodal facilities providing trailer on flat car (TOFC) services are located in West Springfield (Conrail), Palmer (CV), and Chicopee (B&M).

A.2.3. Pipelines

There are presently two petroleum pipelines serving the study area with petroleum products. One is operated by Jet Lines Inc. and runs from New Haven, CT to Ludlow, MA, with branch lines to Bradley International Airport, in Windsor Locks, CT, and Westover Air Force Base, in Chicopee, MA. The other pipeline is operated by Mobil Pipeline Co., providing service between Providence, RI, and Springfield, MA.

A.2.3.1. Jet Lines, Inc.

Jet Lines, Inc., (Jet Lines) is a common carrier of petroleum products within the states of Connecticut and Massachusetts. Jet Lines is controlled by Con Mass Pipeline Company, a subsidiary of Buckeye Pipeline Company, which in turn is a wholly owned subsidiary of Penn Central Corp. Jet Lines' general office is located in Bloomfield, CT, but management control is directed from Emmaus, PA.

The Jet Lines' system includes a trunkline of approximately 111 miles in length. Of this, 93 miles are 12-inch diameter line, 7 miles are 10-inch line, and 11 miles are 8-inch line. There are also a number of spur lines to individual shippers that vary in length and diameter. Characteristics of the pipeline are shown in Exhibit 4.

Petroleum products enter the system at Jet Lines' New Haven Harbor receiving terminals. These products originate from refineries at various locations including the East and Gulf Coast of the United States, and the Virgin Islands. Some petroleum products have been barged up the Connecticut River to East Hartford where they have been transloaded into the pipeline for shipment further north. The trunkline terminates at Ludlow, MA. The products can be taken off at any of the twenty delivery terminals

Exhibit 4

CHARACTERISTICS OF PIPELINES SERVING THE STUDY AREA

Jet Lines, Inc., Bloomfield, Connecticut

Origin: New Haven, CT
Destination: Ludlow, MA
Transports: Petroleum products (gasoline, kerosene, distillates)
Terminals: New Haven, Portland, Cromwell, Rocky Hill, East Hartford, Hartford, Melrose, Scitico, Springfield, Ludlow

Petrochemical Plants: Holyoke, Springfield

1983 Annual Throughput: Received into system: 8,619,014 barrels
Delivered out of system: 8,641,357 barrels

Mobil Pipeline Co., Plainfield, New Jersey

Origin: Providence, RI
Destinations: Holyoke, Leominster, Springfield, MA
Transports: Petroleum products (gasoline, kerosene, distillates)
Terminals: Providence, Springfield, Holyoke, Leominster

Petrochemical Plants: Leominster, Holyoke, Springfield

1983 Annual Throughput: Received into system: 2,596,340 barrels
Delivered out of system: 2,595,441 barrels

Source: Federal Energy Regulatory Commission.

in nine cities located along the line, plus two branch lines. The nine cities are (in order travelling Northward along the trunkline); Portland, Cromwell, Rocky Hill, East Hartford, Hartford, Melrose, Scitico, (all in Connecticut) Springfield, and Ludlow (both in Massachusetts). The branch lines go to Bradley International Airport in Winsor Locks, CT, and Westover Air Force Base in Chicopee, MA as shown in Exhibit 3, above.

A.2.3.2. Mobil Pipeline Company

Mobil Pipeline Company, Inc., operates a petroleum products pipeline between Providence, Rhode Island and western Massachusetts. The branch office that operates this pipeline is located in Plainfield, New Jersey. The branch office has limited authority and the pipeline is primarily managed at the Mobil Pipeline Company's main headquarters, located in Dallas, Texas.

The Mobil Pipeline Company was incorporated on November 25, 1925 in Texas. One-hundred percent of the capital stock is owned by Mobil Oil Corporation, New York City, New York, which in turn, is a wholly owned subsidiary of Mobil Corporation, New York City, New York. The pipeline company primarily functions for the benefit of the parent company as a crude oil and petroleum products transporter. However, the pipeline also provides service to outside refineries and marketers.

The pipeline section that serves the study area consist of approximately 105 miles of line. Most of this line is six inches in diameter, with a few small sections that are eight inches in diameter. Characteristics are shown in Exhibit 4, above.

Petroleum products are generally delivered to the pipeline by water at Providence, Rhode Island. The products then travel in a northwest direction to Massachusetts. At Worcester, MA, the pipeline divides and products can be transported northward to Leominster, MA, or westward to Holyoke, MA. Mobil Chemical Company owns and operates a petrochemical plant in Holyoke, and there are three petrochemical plants located in Leominster owned by other corporations.

The pipeline divides again at approximately five miles East of Holyoke. This branch line goes southward through Springfield, into Connecticut, and terminates at Hartford, CT. As of January 1, 1984, Hartford was eliminated as a destination, and pipeline flows now terminate at Springfield, MA.

A.2.4 Highway System

The highway system consists of the system of roads and the trucking companies that provide the freight transportation.

A.2.4.1. Major Roads

The cities of Springfield and Hartford serve as major junctions of North-South and East-West interstate highways which traverse the length and width of the states. The North-South corridor is I-91, which runs from the Canadian border to Southern Connecticut, East-West access is provided by the Massachusetts Turnpike (I-90) and I-84 in Connecticut. On all interstate highways there unimpeded flows of traffic, with little congestion and no tunnels. In addition to these major corridors, I-29 connects I-90 and I-91 through the City of Springfield. I-291 is a recently constructed spur that connects Holyoke, Chicopee, and Springfield. Route 202 feeds into northwestern Connecticut from the Holyoke/ Springfield, area and skirts to the west of Hartford, turning westward into New York State. Through this highway network, easy access is afforded from the study area to metropolitan centers in New England, New York, and other parts of eastern United States and Canada.

A.2.4.2. Trucking Companies

There are numerous for-hire trucking companies serving the study area. These provide both full truckload and less than truckload (LTL) service. Many of these serve only local areas but there is a large number of interstate motor carriers that provide service to most towns in the area. Exhibit 5 shows 53 regular and irregular route carriers serving the area. In addition there are many private truck fleets that carry freight for their owners. A tandem trailer terminal is located in Chicopee at Massachusetts Turnpike Interchange Number 6.

Many of New England's freight carriers are small, short haul carriers handling feeder and distribution traffic. There is a large concentration of carriers in West Springfield, and most of the urbanized area communities have at least one trucking firm or independent operator. A number of major carriers serving both states in the study area are based in northern Connecticut. Local business also use carriers headquartered in Worcester and Webster, Massachusetts. Conversely, the carriers based in the Hampden and Hampshire Counties serve numerous industries that are outside the region. For example, there are few trucking operations in Franklin County, and consequently some shippers there

Exhibit 5

INTERSTATE MOTOR CARRIERS
SERVING TOWNS IN STUDY AREA

AAA Trucking Corp.	Moskowitz Motor Transportation, Inc.
ABF Freight System, Inc.	National Freight, Inc.
AFS American Freight System, Inc.	New Penn Motor Express, Inc.
A-P-A Transport Corp.	New York Massachusetts Motor Service, Inc.
Arrow Carrier Corporation	Old Dominion Freight Line, Inc.
Beacon Fast Freight Co., Inc.	Overnight Transportation Co.
Berman's Motor Express, Inc.	Penn Yan Express, Inc.
Bilkays Express Company	Pilot Freight Carriers, Inc.
Bowman Transportation, Inc.	Preston Trucking Company, Inc.
Branch Motor Express Company	Red Star Express Lines of Auburn, Inc.
Carolina Freight Carriers Corporation	Riss International Corporation
Carrano Express, Inc.	Roadway Express, Inc.
Cole Express	Ryder/PIE Nationwide, Inc.
Consolidated Freightways	Sanborn's Motor Express, Inc.
Cooper Motor Lines, Inc.	Smith's Transfer Corporation
Daily Express, Inc.	St. Johnsbury Trucking Co., Inc.
Fairbanks Express, Inc.	Sullivan, R.M., Transportation, Inc.
Friedman's Express, Inc.	System Freight, Inc.
Halls Motor Transit	Thurston Motor Lines, Inc. (TML)
Holmes Transportation, Inc.	Transamerican Freight Lines, Inc.
IML Freight Inc.	Transcon Lines
Interstate System	Vallerie's Transportation Service, Inc.
Kulp & Gordon, Inc.	Willey's Express, Inc.
Lombard Bros., Inc.	Wright Trucking, Inc.
Lyons Transportation Lines, Inc.	Yellow Freight System, Inc.
McLean Trucking Company	
Mead, W.L., Inc.	
Mercury Motor Express, Inc.	

Source: National Highway Carriers Directory, Inc.: National Highway and Airway Carriers and Routes, Fall 1984.

Exhibit 6

AIRPORT CHARACTERISTICS

Bradley International Airport
Windsor Locks, CT 06096

Number of Runways: 3

Length of Longest Runway: 9,500 ft.

Aids to Navigation & Landing: All Weather Operation

Method of Fuel Delivery to Airport: Jet Lines Inc., Pipeline direct from New Haven

Types of Products: Jet Fuel

Name of Vendor: Combs Gates

Source: Interview with airport personnel.

rely on Springfield-area carriers. Springfield-based trucking firms also provide nation-wide connections to points in Vermont, New Hampshire, Canada, New York State, and other parts of the Northeast. In this sense, the primary study area exports transportation services to other areas, producing regional income.

A.2.5 Airport System

The only major airport in the study area is Bradley International Airport. The airport is used primarily for commercial passenger air transportation. However, the airport also serves as a terminal for air cargo.

Bradley International Airport is located in Windsor Locks, CT. The aids to navigation and landing facilities at the airport permit all weather operation. There are three runways at the airport. With the longest being 9,500 feet, as shown in Exhibit 6. The airport can be used by most sizes of aircraft including Douglass DC-10s and Boeing-747s.

Westover Air Force Base is located at Chicopee, MA. Aviation facilities are operated and maintained by the U.S. Air Force Reserve 439th Tactical Airlift Wing. Civilian use is authorized for general aviation aircraft. The main runway of 11,600 feet in length was designed for use by B-52 and KC-135 aircraft. Much of the original Air Force property has been released to the Westover Metropolitan Development Corporation for conversion to industrial use. The B&M provides rail service to the property.

A.2.6. Waterway System

The waterway system is described in terms of the physical characteristics of the waterway and the companies that provide service on it.

A.2.6.1. Physical Characteristics

The physical constraints of the Connecticut River restrict the use of large ocean going vessels on the river. The U.S. Army Corps of Engineers maintains the condition of the Connecticut River so that it remains navigable from the mouth at Old Saybrook to Hartford (approximately 52 miles). This requires dredging 15 foot channels through the bars that build up on the outside course of the river, dredging a 15 foot entrance channel through the Saybrook outer bar that blocks the mouth of the river, maintaining a channel width of 300 feet from the mouth to the Lyme

railroad bridge, and maintaining a channel width of 150 feet for the remainder of the river up to Hartford.

During the spring thaw, the river is usually flooded. When this happens, eroded silt and sand is dumped into the river. This can reduce the available depth of water to 10 feet over some shoals. Generally, about half of the 33 bars and shoals need dredging each year. In addition, during many past years, drought conditions have existed which further reduced the channel depth. The maximum dependable channel depth over the course of the Connecticut River is often only 12 feet. Also, starting nine miles from the mouth, the river is fresh water. This causes a vessel to have a deeper draft than it would have in salt water. Therefore, many ocean going deep draft vessels are precluded from using the Connecticut River. Exhibit 7 shows the drafts of vessels using the river during 1982. The 101 tugboat trips at 14 feet show that conditions were better than usual in that year.

Several fixed bridges cross the Connecticut River, with the most constraining vertical clearance at 80 feet until reaching Hartford's Memorial Bridge which has a vertical clearance of only 38.8 feet. There are also three movable bridges with swing or bascule spans. These offer no vertical restrictions. The most horizontally constraining bridge is the railroad bridge in Middletown where the channel width is decreased to 100 feet. Almost all cables crossing the river have a vertical clearance of 100 feet. However, one cable located at Deep River, 24 miles above the mouth, has a vertical clearance of only 65 feet.

During the months of January and February, ice generally forms on the Connecticut River. This requires that vessels using the river during these months have ice-strengthened hulls. In the past, when there has been considerable ice in the Hartford area, it rarely has stopped water deliveries. In the worst case, a tug can be brought in to lead the vessel and break through the ice. About once in every five years, the Coast Guard is called in to break up an ice jam or aid a stuck vessel. Generally, the river traffic is sufficient to keep the ice churned into slush.

A.2.6.2. Water Transportation Companies

As shown by Exhibit 8, ten shipping companies are engaged in water transportation on the Connecticut River. While six of these companies use the river quite frequently, the other four use the river only occasionally.

Exhibit 7

TRIPS AND DRAFTS OF VESSELS UPBOUND
ON THE CONNECTICUT RIVER IN 1982

Draft (feet)	Self-Propelled Vessels			Non-Self Propelled Vessels	
	Passenger and Dry Cargo	Tanker	Tugboat	Dry Cargo Barge	Tank Barge
18	-	-	-	-	1
17	-	-	2	-	-
14	-	-	101	-	1
13	-	64	12	-	31
12	-	62	81	-	249
11	-	9	56	-	63
10	-	1	174	-	24
9	-	-	22	-	5
8	18	-	2	-	1
7	190	-	1	-	-
6 and less	10,668	-	6,462	6,462	2
Total	10,876	136	6,913	6,462	377

Source: U.S. Army Corps of Engineers: Waterborne Commerce of the United States, Part 1, 1982.

Exhibit 8

TRANSPORTATION COMPANIES OPERATING
ON THE CONNECTICUT RIVER

Frequent Service
Amerada Hess Corporation (Spentonbush/Red Star Companies)
Berman Enterprises
Moran Towing and Transportation Company, Inc.
Morania Oil Transportation
Poling Transportation Corporation
Turecamo Towing
Occasion Service
Boston Fuel Transportation Company (Reinauer)
Buchanan Marine, Inc.
Eklof Marine Corporation
McAllister Brothers, Inc.

Source: Interview with dispatcher of Connecticut River Pilot Association.

Exhibit 9 shows the tug and barge fleets of the ten transportation companies that operate in the area. Nine of the companies operate tugs in the area. The largest tug fleet is owned by Moran. Nine of the companies also operate barges in the area. The largest fleet in terms of number of tank barges and total deadweight is operated by Morania Oil Transportation. EKLOF Marine and Poling Transportation both operate several small self-propelled tankers that use the Connecticut River as shown in Exhibit 10.

A list of bulk fuel handling terminals on the Connecticut River is shown in Exhibit 11.

A.3 COMMODITY FLOWS IN THE STUDY AREA

The amount and types of cargo that have moved in and out of the study area give a general indication of the potential demand for barge services in the region. Information describing modal flows into and out of the area is summarized. Freight movements on each mode were analyzed and described in detail below. In addition, barge traffic on the Connecticut River below Hartford was also analyzed.

A.3.1. Modal Traffic

Truck is the dominant mode of transportation in the study area for manufactured products. Exhibit 12 shows the weight and value of cargo transported by all modes into and out of Massachusetts and Connecticut during 1977, the latest year of available statistics. Highway transportation by motor carriers and private trucks amounted by weight to 74 percent inbound and 93 percent outbound in Massachusetts, and 54 percent inbound and 94 percent outbound in Connecticut.

The types and amounts of manufactured products shipped out of Massachusetts and Connecticut are shown in Exhibit 13 in terms of their values, weight and ton-miles shipped.

A.3.2 Railroad Traffic

As shown by Exhibit 14, the largest movement of a commodity into the study area by railroad in 1983 was coal. At 451,489 tons, coal accounts for 71 percent of the total inbound freight

Exhibit-9

TUG AND BARGE FLEETS

Operator	Tugs	Tank Barges		Dry Cargo Barges	
	Number	Number	Total DWT	Number	Total DWT
Amerada Hess Corporation (Spentonbush/Red Star Companies)	10	9	42,619	1	4,286
Boston Fuel Transportation Company (Reinauer)	6	6	27,070	-	-
Berman Enterprises	2	3	9,100	-	-
Buchanan Marine, Inc.	10	-	-	29	43,500
Eklof Marine Corporation	-	1	8,164	-	-
McAllister Brothers, Inc.	10	5	55,526	8	58,406
Moran Towing and Transportation Company, Inc.	12	5	31,874	2	35,189
Morania Oil Transportation (Penn Industries)	8	10	78,322	-	-
Poling Transportation Corporation	4	4	36,914	-	-
Turecamo Towing	6	4	27,469	-	-

Source: Temple, Barker & Sloane, Inc.: Directory of Large American Barges and Associated Towing Vessels.

DWT = Deadweight Tonnage.

Exhibit-10

TANKER FLEETS

Operator	Number of Tankers	Range of Cargo Capacity in Short Tons	Total Capacity in Short Tons
Eklof Marine Corporation	8	583 to 5,676	14,673
Poling Transportation Corporation	4	1,209 to 3,232	8,432

Source: U.S. Army Corps of Engineers: Transportation Lines on the Atlantic, Gulf and Pacific Coasts, 1981-1982.

Exhibit-11

COMMERCIAL BULK FUEL HANDLING TERMINALS

ON THE CONNECTICUT RIVER

Company	Township/City	Capacity in Gallons
Pratt & Whitney	Middletown	3,570,000
Petersons Oil	Middletown	2,247,000
Connecticut Light & Power	Middletown	1,106,667
Itapaco	Portland	N/A
Chevron Oil	Portland	6,992,000
Chevron Asphalt	Portland	N/A
Yankee Terminal	Portland	N/A
Tenneco Oil	Rocky Hill	79,858,000
Rocky Hill Oil	Rocky Hill	1,833,576
Ultramar	Glastonbury	3,658,000
Hess Oil & Chemical	Wethersfield	3,550,000
North East Petroleum Corporation	Wethersfield	N/A
Pratt & Whitney-Wilgoos Labs	East Hartford	12,750,000
Atlas Oil	East Hartford	4,000,000
Texaco	East Hartford	9,147,180
Automatic Comfort	East Hartford	10,620,000
General Oil	East Hartford	2,000,000
Connecticut Natural Gas	Hartford	2,300,000

N/A = Not available.

Sources: U.S. Coast Guard, Captain of the Port, New London, Connecticut
Terminal Operators.

Exhibit 12

SHIPMENTS BY MANUFACTURING ESTABLISHMENTS[1]
INTO AND OUT OF MASSACHUSETTS AND CONNECTICUT
(1977)

	Inbound		Outbound	
	Weight (thousand short tons)	Value ($ million)	Weight (thousand short tons)	Value ($ million)
Massachusetts				
Rail	5,118	3,015	1,190	1,168
Motor carrier	9,646	13,677	8,225	15,610
Private truck	16,031	6,44	14,659	6,510
Air	58	923	44	1,737
Water	3,596	357	20	67
Pipeline	N/A	N/A	N/A	N/A
Parcel	55	1,415	109	2,956
Other/unknown	59	570	309	1,393
Total	34,563	26,398	24,556	29,442
Connecticut				
Rail	4,872	1,449	149	229
Motor carrier	4,720	7,027	2,534	10,453
Private truck	9,442	4,554	9,262	4,004
Air	22	393	18	929
Water	6,952	955	44	87
Pipeline	N/A	N/A	N/A	N/A
Parcel	56	1,178	53	1,639
Other/unknown	61	439	432	1,888
Total	26,125	16,045	12,492	19,229

N/A = Not available.

[1]1977 Census of Transportation, U.S. Department of Commerce, Bureau of the Census, Table 1.

Exhibit 13

OUTBOUND SHIPMENTS FROM MANUFACTURING ESTABLISHMENTS
IN MASSACHUSETTS AND CONNECTICUT[1]

(1977)

SIC Code	Industry	Massachusetts			Connecticut		
		Value ($ Million)	Weight (Thousand short tons)	Traffic (Million ton-miles)	Value ($ Million)	Weight (Thousand short tons)	Traffic (Million ton-miles)
20	Food and kindred products	2,525	4,333	1,183	N/A	N/A	N/A
22	Textile mill products	1,123	509	282	404	85	43
23	Apparel and other products	1,370	121	49	347	31	11
24	Lumber or wood products	242	268	4	75	645	31
25	Furniture or fixtures	275	99	21	178	45	21
26	Paper or allied products	1,697	1,689	521	529	676	75
27	Printing and publishing	1,733	684	214	791	176	23
28	Chemicals or allied products	1,573	3,663	1,179	1,555	2,389	705
29	Petroleum or coal products	172	5,420	113	67	4,293	29
30	Rubber or misc. plastic products	1,508	997	818	623	136	95
31	Leather and leather products	766	101	64	34	1	(Z)
32	Stone, clay, or glass products	630	4,704	127	270	139	2
33	Primary metal products	1,037	280	128	1,658	937	328
34	Fabricated metal products	1,954	559	214	1,828	302	167
35	Machinery, except electrical	4,374	318	197	2,490	222	172
36	Electrical or electronic machinery	3,348	161	136	1,693	147	93
37	Transportation equipment	1,554	329	104	3,970	413	65
38	Instruments or related products	2,445	140	40	1,145	55	37
39	Misc. manufactured products	1,116	181	158	608	66	50
	TOTAL	29,442	24,604	5,601	19,229	12,691	2,162

[1]Source: *1977 Census of Transportation*, U.S. Department of Commerce, Bureau of the Census, Table 9.
N/A = Not available.
(Z) = Less than half unit of measure.

Exhibit 14

INBOUND FREIGHT VIA RAIL INTO STUDY AREA

(1983)

Commodity	Origin	Short Tons
Paper waste and scrap	Boston, MA	4,036
Wood scrap and waste	Albany, NY	5,045
Paper waste and scrap	Philadelphia, PA	4,036
Residual fuel oil	Boston, MA	10,959
Residual fuel oil	Hartford/New Haven, CT	80,022
Distillate fuel oil	Boston, MA	42,185
Hydraulic cement	Albany, NY	14,121
Alcohols	New York, NY	7,721
Coal	Pennsylvania	376,589
Coal	West Virginia	74,900
Liquefied petroleum gas	Philadelphia, PA	8,865
Iron or steel	Baltimore, MD	7,862
	Total	636,341

Source: Interstate Commerce Commission: Waybill Sample, 1983.

via railroad into the area. Due to the long hauls from its origins in Pennsylvania and West Virginia, it accounts for over 85 percent of the revenue generated by inbound commodities.

Other major commodities that are shipped via rail into the study area include residual and distillate fuel oil, iron and steel, liquified petroleum gas, paper and wood waste, and hydraulic cement.

The largest flow outbound from the study area via railroad was 110,901 tons of crushed stone and gravel, as shown in Exhibit 15. This accounts for more than 50 percent of the tonnage in 1983. Other commodities outbound from the study area include, plastic materials, iron and steel scrap, and unclassified scrap.

A.3.3 Pipeline Traffic

The pipelines that serve the study area transport petroleum products exclusively. The largest single commodity that is shipped into the study area by pipeline has historically been distillate fuel oil. The throughput of gasoline has generally increased over the 1970s, and is now the second largest commodity volume shipped by pipeline to the study area. Other commodities that are brought to the study area by pipelines include jet fuel (for commercial and military use), and kerosene.

Based upon a map dated 1975, provided by the Federal Energy Regulatory Commission (FERC), the maximum capacity of the Jet Line pipeline is 27 million barrels per year or 75,000 barrels per day. The actual annual throughput has never been close to this figure. In 1978, when throughput in the pipeline peaked, only 51 percent of the capacity was used. Annual product throughput has ranged between 8.4 and 13.8 million barrels per year since 1970 as shown in Exhibit 16. In addition to the No. 2 fuel oil shipments which comprise 75 percent of the total, Jet Lines also handles jet fuel (JP1A and JP4) at an average annual volume of 1.5 million barrels since 1975. Most of these products are shipped to three points: Bradley International Airport, Pratt & Whitney Aircraft in the Hartford area, and Westover Air Force Base.

Exhibit 15

OUTBOUND FREIGHT VIA RAIL FROM STUDY AREA

(1983)

Commodity	Destination	Short Tons
Plastic material	New York, NY	9,800
Plastic material	Boston, MA	28,567
Crushed stone	Hartford/New Haven, CT	97,893
Gravel	Hartford/New Haven, CT	13,008
Iron or steel scrap	New York, NY	6,760
Unclassified waste and scrap	Boston, MA	64,530
		220,558

Source: Interstate Commerce Commission: Waybill Sample, 1983.

Exhibit 16

JET LINES, INC.

ANNUAL PRODUCT THROUGHPUT

(thousands of barrels)

Year	Distillate Residential Sector	Jet Fuel (JP4) Transportation	Jet Fuel (JP4) Military	Gasoline Transportation	Total
1970	7,747	-	1,007	-	8,493
1971	7,501	-	1,161	342	9,197
1972	8,843	-	592	1,255	10,898
1973	9,506	59	344	946	11,027
1974	8,498	1,333	225	562	10,783
1975	8,138	1,429	219	671	10,584
1976	9,526	1,254	222	823	11,964
1977	8,990	1,400[E]	235[E]	1,425[E]	12,188
1978	10,130	1,292	227	2,013	13,801
1979	9,241	1,420	194	2,013	12,984
1980	7,806	1,261	276	1,874	11,286
1981	7,320	942	284	1,074	9,686
1982	7,580	N/A	N/A	N/A	9,153
1983	7,615	N/A	N/A	N/A	8,641

E = Estimated.
N/A = Not available.

Source: Federal Energy Regulatory Commission: Depreciation Analysis of Jet Lines, Inc., 1983.

The maximum capacity on the Mobil Pipeline Company's Rhode Island to Massachusetts pipeline was estimated in 1975 at 5.8 million barrels annually or 16,000 barrels per day. The 1983 throughput for the system was 2.6 million barrels or 45 percent of system capacity. The highest throughput during the years 1978 through 1983 occurred in 1979. In that year 3.8 million barrels were delivered out of the system or 66 percent of total system capacity as shown in Exhibit 17. The main products transported via the Mobil Pipeline Company's pipeline are gasoline, kerosene, and distillate fuel oil. Since 1979, all of these have been decreasing in volume, with a slight upturn in 1983 for kerosene and distillate fuel oil, and in 1982 for gasoline.

A.3.4 Highway Traffic

Of the 22,884,000 tons of manufactured products that were loaded in trucks in Massachusetts in 1977 (the most recent reported year of the Census of Transportation), 14,214,000 or 62 percent remained within the state. Exhibit 18 shows the data. For Connecticut, 50 percent remained. Other New England states received 6.5 percent of Massachusetts and 3.1 percent of Connecticut truck shipments. Middle Atlantic states received 12 percent and 13 percent, respectively. The average lengths of haul were 197 and 162 miles.

A.3.5 Air Traffic

As shown by Exhibit 19, almost half of the air cargo that was shipped from the study area via Bradley International in 1981 was U.S. mail. The total annual amount of air cargo, shipped, 19,838 tons, is insignificant when compared to a barge load of 2,000 to 3,000 tons. Aircraft are generally used for high value, time sensitive cargoes, and the cost for using aircraft is high when compared to the weight of the items being shipped. Water transportation is more attractive to shippers of high volume, low value cargoes. Therefore, aircraft and barges rarely compete for the same cargoes.

In 1981, USAir was the largest in terms of passengers boarding at Bradley International Airport (over 332,000). However, United Air Lines was the largest in moving freight through the airport (over 8,600 enplaned revenue tons). In total, 1,162,993 passengers boarded and 19,839 revenue tons were loaded at Bradley International Airport in 1981.

Exhibit 17

MOBIL PIPELINE COMPANY

ANNUAL PRODUCT THROUGHPUT

(barrels delivered)

Year	Distillate Fuel Oil	Kerosene	Gasoline	Total
1978	1,114,789	122,906	2,248,195	3,485,890
1979	1,191,253	138,610	2,494,627	3,824,490
1980	956,752	94,191	2,146,797	3,197,740
1981	883,471	86,682	2,082,530	3,052,683
1982	352,148	47,035	2,122,187	2,521,370
1983	463,076	49,382	2,082,983	2,595,441

Source: Federal Energy Regulatory Commission.

Exhibit 18

TRUCK SHIPMENTS BY MANUFACTURING ESTABLISHMENTS

1977

Origin State/Mode	Destination											
	All United States			Massachusetts		Connecticut		Other New England		Middle Atlantic	
	Value ($ million)	Tons (thousand)	Ton-Miles (million)	Value ($ million)	Tons (thousand)	Value ($ million)	Tons (thousand)	Value ($ million)	Tons (thousand)	Value ($ million)	Tons (thousand)
Massachusetts											
For-Hire Truck	15,610	8,225	3,704	2,373	1,714	584	457	717	905	3,959	2,086
Private Truck	6,510	14,659	810	3,603	12,500	216	378	715	583	836	668
Total	21,120	22,884	4,514	5,980	14,214	800	835	1,432	1,488	4,795	2,754
Connecticut											
For-Hire Truck	10,453	2,534	1,409	398	95	546	145	195	43	2,604	827
Private Truck	4,004	9,262	498	295	984	2,510	7,057	70	318	548	719
	14,457	11,796	1,907	693	1,079	3,056	7,202	265	361	3,352	1,546

Source: U.S. Department of Commerce Census of Transportation, 1977.

Exhibit 19

ENPLANED REVENUE PASSENGERS, ENPLANED REVENUE TONS OF CARGO AND MAIL, AND AIR TRAFFIC HUB CLASSIFICATIONS, BY TYPE OF OPERATION, BY TYPE OF SERVICE, BY COMMUNITY, AND BY CARRIER
12 MONTHS ENDED DECEMBER 31, 1981

Area, state or country Community (Airport name) Carrier Type of operation Type of service Hub type and percent of enplanements		Enplaned Passengers	Enplaned revenue tons						
					U.S. Mail			Foreign Mail	Total cargo and Mail
			Freight	Express	Priority	Nonpriority	Total		
1		2	3	4	5	6	7	8	9
Connecticut									
Hartford/Springfield/Westfield (Bradley International) M 0.43									
AA Domestic	Scheduled	92,740	243.41	12.52	191.80	379.01	570.81		826.74
	Nonscheduled	112							
	All Services	92,852	243.41	12.52	191.80	379.01	570.81		826.74
AK Domestic	Scheduled	11,992							
AL Domestic	Scheduled	332,467	1,330.07	64.37	2,144.50		2,144.50		3,538.94
	Nonscheduled	81							
	All Services	332,548	1,330.07	64.37	2,144.50		2,144.50		3,538.94
BN Domestic	Scheduled	7,903	31.77	.03	135.22		135.22		167.02
DL Domestic	Scheduled	224,374	2,135.90	40.77	1,130.18		1,130.18		3,306.85
EA Domestic	Scheduled	189,331	1,269.41	39.47	889.59	7.15	896.74		2,185.62
	Nonscheduled	668							
	All Services	189,999	1,269.41	39.47	889.59	7.15	896.74		2,185.62
NE Domestic	Scheduled	7,650	16.90		38.72		38.72		55.62
TI Domestic	Scheduled	51,274	81.30	1.35	195.91		195.91		278.56
	Non scheduled	38							
	All Services	51,312	81.30	1.35	195.91		195.91		278.56
TW Domestic	Scheduled	31,983	132.19	.34	222.95	510.04	732.99		865.52
UA Domestic	Scheduled	203,277	5,491.60	138.29	2,344.03	639.86	2,983.89		8,613.78
	Nonscheduled	2,508							
	All Services	205,785	5,491.60	138.29	2,344.03	639.86	2,983.89		8,613.78
UR Domestic	Scheduled	6,584							
	Nonscheduled	11							
	All Services	6,595							
Community Total									
Domestic	Scheduled	1,159,575	10,712.55	297.14	7,292.90	1,536.06	8,828.96		19,838.65
	Nonscheduled	3,418							
	All services	1,162,993	10,712.55	297.14	7,292.90	1,536.06	8,828.96		19,838.65

Source: Airport Activity Statistics, U.S. Department of Transportation.

A.3.6 Waterway Traffic

As shown by Exhibit 20, in 1982 the largest flows of commodities on the Connecticut River were gasoline, residual fuel oil and distillate fuel oil. These three commodities account for more than 1.4 million or 95 percent of the tons shipped on the river. The volume of gasoline transported on the river has been increasing since 1979 at an annual rate of 20.6 percent. Residual fuel oil has historically been the largest volume moved on the river, often over one million tons per year. However, in 1982, residual fuel oil fell abruptly to 600,000 tons and was replaced by gasoline as the largest movement. Commodities that also moved recently on the Connecticut River include kerosene, jet fuel, and asphalt.

Origins and destinations of petroleum products and chemicals received on the Connecticut River and at New Haven during the years 1978 to 1982 are shown in Exhibits 21 to 27. Gasoline shipments by water in Exhibit 21 are principally originated in New York, which is also the principal origin for New Haven shipments. Jet fuel shipments up the river in Exhibit 22 have various origins including New Haven, Boston, and New York. For New Haven destinations, the principal origin is New York. Kerosene to Connecticut River destinations originate in Fall River, New York, or New Haven as shown in Exhibit 23. New York is the principal source for New Haven. Distillate fuel oil in Exhibit 24 is principally delivered to the Connecticut River from New York with substantial loads originating in New Haven and New London. Shipments to New Haven generally originate in New York. Residual fuel oil on the Connecticut River has a similar pattern shown in Exhibit 25 as for distillate fuel oil, but not for New Haven deliveries where a wide variety of origins are shown and New York is not dominant. Exhibit 26 shows asphalt, tar and pitches originating principally in New York for deliveries on the Connecticut River and New Haven. A wide variety of petroleum products and chemicals are delivered to New Haven as shown in Exhibit 27, but no traffic is shown for the Connecticut River.

Exhibit 20

FREIGHT TRAFFIC ON THE CONNECTICUT RIVER, BELOW HARTFORD

(thousands of short tons)

		1970		1971		1972		1973		1974		1975	
Code No.	Commodity	Receipts	Shipments	Receipts	Shipments	Receipts	Shipments	Receipts	Shipments	Receipts	Shipments	Receipts	Shipments
2811	Crude tar, oil, gas products	26.4		25.1		21.4		28.0		14.5		5.0	
2911	Gasoline	1,059.6	2.9	1,109.7	0.5	861.2		842.6		785.0		723.3	1.2
2912	Jet fuel	304.6	3.7	235.7		276.9		261.8		65.0		25.9	
2913	Kerosene	42.4		99.4		82.0		64.6		35.9		17.1	
2914	Distillate fuel oil	686.1	3.0	748.4	2.0	681.0		442.5		386.4	5.9	345.5	3.4
2915	Residual fuel oil	1,607.7		1,430.4		1,487.5		1,760.1		1,699.6		1,376.9	1.1
2917	Naptha, petroleum solvents	2.2		0.8									
2918	Asphalt, tar, and pitches	51.8		70.2		82.2		72.2		52.4		58.5	
3241	Building cement	14.2		6.1									
3511	Machinery, except electrical								0.2			0.2	
3611	Electrical machinery & equipment							0.6	0.3				
3411	Fabricated metal products											0.2	
	Total	3,795.8	10.4	3,733.8	3.3	3,413.8	0.0	3,472.4	0.5	3,048.4	5.9	2,552.9	5.7

Exhibit 20 (continued)

FREIGHT TRAFFIC ON THE CONNECTICUT RIVER, BELOW HARTFORD

(thousands of short tons)

		1976		1977		1978		1979		1980		1981		1982	
Code No.	Commodity	Receipts	Shipments	Receipts	Shipments	Receipts	Shipments	Receipts	Shipments	Receipts	Shipments	Receipts	Shipments	Receipts	Shipments
1442	Sand, gravel, crushed rock	1.1										0.8			
2811	Crude, tar, oil, gas products	11.9		12.6											
2911	Gasoline	745.7		625.1		499.6		369.6		407.7		484.8		648.5	2.1
2912	Jet fuel	33.8		79.3		48.1		48.3		46.2		31.0		25.4	
2913	Kerosene	4.1		4.4		8.0		23.7		9.1		8.3		17.0	
2914	Distillate fuel oil	293.2		350.2	5.9	257.1		163.7	1.7	191.4	2.2	187.5		216.4	
2915	Residual fuel oil	1,070.7	0.3	1,000.8	1.4	1,056.5		751.5		1,070.5		1,041.0		605.9	
2918	Asphalt, tar, and pitches	65.3		68.5		83.4		63.8		44.8		47.4		30.3	
3511	Machinery, except electrical											0.3			
3611	Electrical machinery & equipment		0.3												
	Total	2,225.8	0.6	2,140.9	7.3	1,950.7	0.0	1,412.6	1.7	1,769.7	2.2	1,801.1	0.0	1,543.5	2.1

Source: Army Corps of Engineers: Waterborne Commerce of the United States, Part 1.

Exhibit 21

WATERBORNE COMMERCE TO HARTFORD AND NEW HAVEN

GASOLINE

(2911)

	1978		1979		1980		1981		1982	
From	Short Tons	Percent	Short Tons	Percent	Short Tons	Percent	Short Tons	Percent	Short Tons	Percent
To Hartford										
Fall River	-	-	-	-	-	-	-	-	2,342	0.4
New Haven	-	-	3,960	1.1	5,067	1.3	-	-	3,204	0.5
New London	2,119	0.4	-	-	1,579	0.4	-	-	-	-
New York	497,449	99.6	365,650	98.9	391,226	98.3	484,812	100.0	642,946	99.1
Total	499,568	100.0	369,610	100.0	397,872	100.0	484,812	100.0	648,492	100.0
To New Haven										
Boston	7,784	0.2	-	-	-	-	6,440	0.2	-	-
Fall River	-	-	-	-	-	-	-	-	1,946	0.1
Providence	8,211	0.2	4,252	0.1	7,971	0.3	-	-	-	-
New London	2,114	0.1	5,379	0.2	-	-	-	-	-	-
New York	1,598,594	46.4	1,440,305	47.0	1,435,901	59.1	1,678,504	64.7	1,813,754	70.7
Albany	-	-	-	-	6,246	0.3	-	-	-	-
Philadelphia	311,723	9.0	329,908	10.8	213,457	8.8	227,243	8.8	261,576	10.2
Wilmington (DE)	134,653	3.9	223.037	7.3	163,442	6.7	195,776	7.5	223,244	8.7
Paulsboro	20,802	0.6	-	-	-	-	16,244	0.6	14,786	0.6
Camden	4,587	0.1	-	-	-	-	-	-	-	-
Glouster City	-	-	-	-	6,394	0.3	-	-	-	-
Marcus Hook	59,779	1.7	89,072	2.9	70,682	2.9	64,579	2.5	6,316	0.2
Baltimore	-	-	-	-	-	-	10,484	0.4	-	-
Newport News	251,949	7.3	-	-	37,104	1.5	208,205	8.0	235,139	9.2
Wilmington (NC)	-	-	-	-	16,342	0.7	-	-	-	-
Guayanilla	14,286	0.4	47,434	1.5	60,022	2.5	-	-	-	-
Christiansted	889,428	25.8	791,378	25.9	331,733	13.6	186,537	7.2	-	-
Ponce	47,464	1.4	-	-	-	-	-	-	-	-
New Orleans	1,609	0.0	-	-	-	-	-	-	-	-
Port Arthur	-	-	8,149	0.3	20,442	0.8	-	-	-	-
Corpus Christi	21,616	0.6	41,605	1.4	11,808	0.5	-	-	-	-
Houston	72,692	2.1	80,509	2.6	49,822	2.0	-	-	10,040	0.4
Total	3,447,291	100.0	3,061,028	100.0	2,431,366	100.0	2,594,012	100.0	2,566,801	100.0

Source: Division of Domestic Ocean Shipping, Maritime Administration.

Exhibit 22

WATERBORNE COMMERCE TO HARTFORD AND NEW HAVEN

JET FUEL

(2912)

	1978		1979		1980		1981		1982	
From	Short Tons	Percent	Short Tons	Percent	Short Tons	Percent	Short Tons	Percent	Short Tons	Percent
					To Hartford					
Boston	-	-	9,398	23.3	18,159	40.2	-	-	-	-
Mellville	-	-	-	-	-	-	6,410	20.7	-	-
Bridgeport	-	-	3,340	8.3	-	-	-	-	-	-
New Haven	12,007	26.0	4,950	12.3	16,720	37.0	15,883	51.3	10,592	41.7
New York	34,225	74.0	15,183	37.6	3,571	7.9	8,666	28.0	14,799	58.3
Wilmington	-	-	7,453	18.5	6,709	14.9	-	-	-	-
Total	46,232	100.0	40,324	100.0	45,159	100.0	30,959	100.0	25,391	100.0
					To New Haven					
Boston	-	-	-	-	-	-	4,057	1.9	-	-
Providence	-	-	5,119	1.9	-	-	-	-	-	-
New York	92,191	42.5	138,548	50.0	158,610	76.4	153,420	71.4	127,175	79.8
Albany	-	-	-	-	-	-	10,557	4.9	15,104	9.5
Philadelphia	50,827	23.4	37,802	13.6	17,992	8.7	8,364	3.9	6,919	4.3
Wilmington	-	-	-	-	9,303	4.5	26,964	12.5	-	-
Marcus Hook	-	-	-	-	-	-	11,385	5.3	-	-
Baltimore	-	-	-	-	4,266	2.1	-	-	-	-
Pascagoula	-	-	9,370	3.4	-	-	-	-	-	-
New Orleans	2,700	1.2	-	-	-	-	-	-	-	-
Baton Rouge	-	-	13,294	4.8	-	-	-	-	-	-
Destrehan	-	-	4,254	1.5	-	-	-	-	-	-
Port Arthur	11,574	5.3	4,538	1.6	-	-	-	-	-	-
Corpus Christi	59,559	27.5	23,841	8.6	10,593	-	-	-	-	-
Christiansted	-	-	29,032	10.5	6,955	3.3	-	-	-	-
Houston	-	-	11,202	4.1	-	-	-	-	10,198	6.4
Total	216,851	100.0	277,000	100.0	207,719	100.0	214,729	100.0	159,396	100.0

Source: Division of Domestic Ocean Shipping, Maritime Administration.

Exhibit 23

WATERBORNE COMMERCE TO HARTFORD AND NEW HAVEN

KEROSENE

(2913)

	1978		1979		1980		1981		1982	
From	Short Tons	Percent	Short Tons	Percent	Short Tons	Percent	Short Tons	Percent	Short Tons	Percent
					To Hartford					
Fall River	-	-	-	-	-	-	-	-	4,899	47.7
New York	4,775	100.0	23,680	100.0	9,142	80.1	8,258	100.0	5,364	52.3
New Haven	-	-	-	-	2,276	19.9	-	-	-	-
Total	4,775	100.0	23,680	100.0	11,418	100.0	8,258	100.0	10,263	100.0
					To New Haven					
Fall River	-	-	2,134	5.0	-	-	-	-	782	1.3
Providence	-	-	1,270	3.0	-	-	-	-	-	-
Bridgeport	-	-	173	0.4	-	-	-	-	-	-
New York	38,703	78.7	33,175	78.0	15,120	78.5	45,118	100.0	39,497	64.5
Philadelphia	3,569	7.3	-	-	1,046	5.4	-	-	-	-
Baltimore	-	-	-	-	2,141	11.1	-	-	-	-
Humacao	-	-	3,586	8.5	-	-	-	-	-	-
Baton Rouge	2,221	4.5	-	-	-	-	-	-	-	-
Houston	4,700	9.6	2,212	5.2	950	4.9	-	-	20,934	34.2
Total	49,193	100.0	42,550	100.0	19,257	100.0	45,118	100.0	61,213	100.0

Source: Division of Domestic Ocean Shipping, Maritime Administration.

Exhibit 24

WATERBORNE COMMERCE TO HARTFORD AND NEW HAVEN

DISTILLATE FUEL OIL

(2914)

	1978		1979		1980		1981		1982	
From	Short Tons	Percent	Short Tons	Percent	Short Tons	Percent	Short Tons	Percent	Short Tons	Percent
					To Hartford					
Fall River	-	-	-	-	-	-	1,927	1.0	8,875	4.1
Providence	-	-	-	-	-	-	7,006	2.7	-	-
New Haven	40,339	15.7	17,420	12.4	6,169	8.5	6,994	3.7	8,111	3.7
New London	43,505	16.9	13,520	9.6	7,993	11.0	80,067	42.7	-	-
New York	173,222	67.4	109,475	7.8	58,611	80.5	91,476	48.8	199,422	92.2
Total	257,066	100.0	140,415	100.0	72,773	100.0	187,470	100.0	216,408	100.0
					To New Haven					
Portland	18,558	0.6	-	-	-	-	-	-	-	-
Searsport	13,431	0.4	-	-	-	-	-	-	-	-
Boston	12,068	0.4	14,602	0.5	-	-	4,040	0.2	-	-
Fall River	-	-	5,627	0.2	-	-	44,996	2.3	-	-
Providence	-	-	8,512	0.3	26,566	1.1	-	-	-	-
Bridgeport	6,123	0.2	8,043	0.3	-	-	-	-	-	-
Hartford	-	-	1,701	0.1	-	-	-	-	-	-
New Haven	19,981	0.7	-	-	-	-	-	-	-	-
New London	4,500	0.2	23,853	0.8	51,702	2.1	14,195	0.7	1,368	0.1
New York	1,399,085	46.8	1,587,804	53.9	1,598,750	64.2	1,583,480	79.4	1,709,488	87.9
Albany	9,715	0.3	-	-	2,427	0.1	8,356	0.4	-	-
Philadelphia	155,874	5.2	182,183	6.2	132,865	5.3	36,806	1.8	18,721	1.0
Marcus Hook	-	-	-	-	57,300	2.3	-	-	-	-
Wilmington	99,331	3.3	15,553	0.5	15,960	0.6	15,002	0.8	3,805	0.2
Paulsboro	43,094	1.4	-	-	29,687	1.2	9,880	0.5	-	-
Norfolk	-	-	-	-	27,737	1.1	-	-	-	-
Newport News	148,070	5.0	-	-	13,080	0.5	-	-	-	-
New Orleans	14,986	0.5	-	-	-	-	-	-	7,530	0.4
Baton Rouge	130,726	4.4	266,888	9.1	136,562	5.5	116,150	5.8	33,876	1.7
Destrehan	12,920	0.4	27,843	0.9	-	-	-	-	-	-
Port Arthur	151,008	5.1	68,904	2.3	11,852	0.5	-	-	-	-
Beaumont	38,952	1.3	-	-	-	-	-	-	-	-
Corpus Christi	277,126	9.3	76,948	2.6	12,160	0.5	129,348	6.5	-	-
Humacao	19,973	0.7	55,192	1.9	12,160	0.5	-	-	63,131	3.2
San Juan	31,016	1.0	31,551	1.1	22,101	0.9	-	-	36,718	1.9
Ponce	6,882	0.2	-	-	-	-	-	-	-	-
Guayanilla	18,357	0.6	20,583	0.7	6,066	0.2	-	-	-	-
Christiansted	119,941	4.0	321,283	10.9	174,069	7.0	33,138	1.7	-	-
Houston	237,567	7.9	228,178	7.7	159,239	6.4	-	-	69,245	3.6
Total	2,989,284	100.0	2,945,248	100.0	2,490,283	100.0	1,995,391	100.0	1,943,882	100.0

Source: Division of Domestic Ocean Shipping, Maritime Administration.

Exhibit 25

WATERBORNE COMMERCE TO HARTFORD AND NEW HAVEN

RESIDUAL FUEL OIL

(2915)

From	1978		1979		1980		1981		1982	
	Short Tons	Percent	Short Tons	Percent	Short Tons	Percent	Short Tons	Percent	Short Tons	Percent
To Hartford										
New Haven	86,281	8.2	65,617	8.7	86,764	8.1	43,822	4.2	53,086	8.8
New London	712,683	67.6	481,696	64.1	511,486	48.0	365,209	35.1	-	-
New York	255,503	24.2	204,164	27.2	468,129	43.9	631,929	60.7	552,851	91.2
Total	1,054,467	100.0	751,477	100.0	1,066,379	100.0	1,040,960	100.0	605,937	100.0
To New Haven										
Boston	24,661	1.8	34,397	2.8	70,443	6.0	-	-	-	-
Fall River	6,517	0.5	-	-	-	-	-	-	-	-
Providence	19,647	1.5	-	-	-	-	-	-	-	-
Bridgeport	-	-	86,887	7.0	128,515	10.9	187,565	12.7	-	-
New London	9,559	0.7	-	-	7,233	0.6	-	-	-	-
New York	371,617	27.8	256,195	20.5	256,439	21.8	314,795	21.3	204,470	18.0
Albany	-	-	-	-	-	-	-	-	8,324	0.7
Philadelphia	393,422	29.4	336,427	27.0	246,938	21.0	199,643	13.5	123,467	10.9
Paulsboro	15,679	1.2	66,501	5.3	107,930	9.2	373,405	25.3	388,957	34.2
Marcus Hook	-	-	16,561	1.3	13,148	1.1	5,035	0.3	42,530	3.7
Glouster City	-	-	-	-	25,901	2.2	30,230	2.0	-	-
Baltimore	-	-	-	-	-	-	22,619	1.5	-	-
New Orleans	-	-	19,161	1.5	34,406	2.9	-	-	-	-
Baton Rouge	67,057	5.0	29,214	2.3	32,137	2.7	-	-	115,908	10.2
Destrehan	-	-	-	-	31,371	2.7	-	-	101,889	9.0
Gramercy	-	-	-	-	-	-	47,185	3.2	-	-
St. Rose	-	-	-	-	74,531	6.3	-	-	58,084	5.1
Lake Charles	-	-	10,731	0.9	-	-	-	-	-	-
Corpus Christi	68,923	5.1	115,984	9.3	-	-	114,841	7.8	-	-
Texas City	-	-	52,279	4.2	-	-	-	-	-	-
Christiansted	354,075	26.5	143,929	11.5	-	-	-	-	16,438	1.4
Houston	7,410	0.6	79,266	6.4	145,878	12.4	181,754	12.3	77,170	6.8
Total	1,338,567	100.0	1,247,522	100.0	1,174,870	100.0	1,477,072	100.0	1,137,237	100.0

Source: Division of Domestic Ocean Shipping, Maritime Administration.

Exhibit 26

WATERBORNE COMMERCE TO HARTFORD AND NEW HAVEN

ASPHALT, TAR, AND PITCHES

(2918)

	1978		1979		1980		1981		1982	
From	Short Tons	Percent	Short Tons	Percent	Short Tons	Percent	Short Tons	Percent	Short Tons	Percent
					To Hartford					
New York	83,444	100.0	63,767	100.0	30,196	67.4	45,134	95.2	30,326	100.0
Baltimore	-	-	-	-	14,587	32.6	2,293	4.8	-	-
Total	83,444	100.0	63,767	100.0	44,783	100.0	47,427	100.0	30,326	100.0
					To New Haven					
New York	48,159	100.0	14,416	100.0	32,379	61.9	55,608	81.9	57,252	100.0
Baltimore	-	-	-	-	18,103	34.6	12,261	18.1	-	-
Newport News	-	-	-	-	1,818	3.5	-	-	-	-
Total	48,159	100.0	14,416	100.0	52,300	100.0	67,869	100.0	57,252	100.0

Source: Division of Domestic Ocean Shipping, Maritime Administration.

Exhibit 27

WATERBORNE COMMERCE TO HARTFORD AND NEW HAVEN

OTHER COMMODITIES

		1978		1979		1980		1981		1982	
From	Commodity	Short Tons	Percent	Short Tons	Percent	Short Tons	Percent	Short Tons	Percent	Short Tons	Percent
						To New Haven					
Portsmouth	Naphtha (2917)	19,408	3.6	37,279	7.5	6,458	1.7	16,984	3.9	-	-
New York	Naphtha (2917)	10,349	1.9	-	-	-	-	8,668	2.0	34,432	10.4
Albany	Naphtha (2917)	-	-	11,859	2.4	19,398	5.1	-	-	-	-
Wilmington	Naphtha (2917)	-	-	-	-	5,179	1.4	-	-	-	-
Paulsboro	Naphtha (2917)	2,758	0.5	2,969	0.6	15,669	4.1	10,904	2.5	-	-
Houston	Naphtha (2919)	-	-	-	-	10,901	2.9	-	-	-	-
Boston	Pet & Coal Prod. (2991)	-	-	-	-	837	0.2	731	0.2	-	-
New York	Pet & Coal Prod. (2991)	-	-	-	-	8,956	2.3	14,198	3.2	11,323	3.4
Albany	Pet & Coal Prod. (2991)	-	-	-	-	149	0.04	-	-	-	-
Paulsboro	Pet & Coal Prod. (2991)	10,257	1.9	-	-	6,227	1.6	31,898	7.3	-	-
St. Rose	Pet & Coal Prod. (2991)	-	-	-	-	678	0.2	-	-	-	-
New York	Caustic Soda (2810)	23,852	4.4	28,488	5.7	12,031	3.2	8,569	2.0	-	-
Lake Charles	Caustic Soda (2810)	16,758	3.1	-	-	-	-	-	-	-	-
Freeport	Caustic Soda (2810)	-	-	-	-	-	-	-	-	5,796	1.8
New York	Basic Ch. (2819)	939	0.2	-	-	-	-	-	-	-	-
Norfolk	Basic Ch. (2819)	-	-	-	-	777	0.2	-	-	-	-
Freeport	Basic Ch. (2819)	-	-	6,786	1.4	-	-	9,725	2.2	6,046	1.8
Texas City	Basic Ch. (2819)	332,431	61.1	292,163	59.1	154,750	40.6	198,758	45.6	168,834	51.0
Houston	Basic Ch. (2819)	5,526	1.0	-	-	45,568	11.9	41,684	9.6	19,984	6.0
New York	Sulphuric Acid (2917)	14,650	2.7	16,300	3.3	10,200	2.7	5,300	1.2	-	-
Paulsboro	Lub Oil (2916)	536	0.1	2,529	0.5	-	-	-	-	-	-
Baton Rouge	Alcohols (2813)	-	-	1,128	0.2	-	-	-	-	-	-
Beaumont	Alcohols (2813)	14,201	2.6	3,706	0.7	6,573	1.7	-	-	-	-
Texas City	Alcohols (2813)	84,987	15.6	87,138	17.6	68,416	17.9	87,719	20.1	79,755	24.1
Houston	Alcohols (2813)	7,196	1.3	4,229	0.9	8,719	2.3	1,157	0.3	4,828	1.5
Total		543,848	100.0	494,238	100.0	381,486	100.0	435,991	100.0	330,998	100.0

Source: Division of Domestic Ocean Shipping, Maritime Administration.

B. ECONOMIC BASELINE

B.1 INTRODUCTION

The primary study area was defined as that within a half-hour drayage to or from a barge facility on the Connecticut River; it includes Hampden and Hampshire counties in Massachusetts and the northern portion of Hartford County in Connecticut. Franklin County in Massachusetts and Tolland County in Connecticut are included as the secondary area.

Because of their economic diversity, and political separation, the Massachusetts counties and Hartford County are addressed separately in the baseline data/industrial trends section.

Baseline data and economic forecasting information was provided by Regional Economic Models, Inc. (REMI). The REMI computerized structural model of the region examines historical and current information on population, employment, production, consumption, and income at the county level. Detailed tables of historical demographic and economic data are found in Appendix B. Projections of these data are provided in Appendix C.

The information provided by REMI provides an overview of the industrial trends and changes that have occurred in the region since 1967, when consistent data became available, and provides forecasts up to the year 1995. By looking at historical, current, and projected industrial trends, it is possible to identify which industries within the region could potentially benefit from the proposed extension of navigation on the Connecticut River.

B.1.1. Demographic Data

In the northern part of the region, Hampden and Hampshire counties have been growing in population from about 571,000 in 1967 to nearly 590,000 in 1984. However, as a percentage of the U.S. population, this area is not keeping pace with the rest of the country.

During the 50-year period, from 1932 to 1982 population in Massachusetts increased at only one-half the rate of the total U.S. population, while Connecticut increased at a slightly more rapid rate than the total United States as shown in Exhibit 28. In both cases, population increases were greatest near the large cities. In Massachusetts, population increased most rapidly in the eastern portion of the state; in Connecticut, growth was

Exhibit 28

CHANGES IN POPULATION, IN THE STUDY AREA AND THE TOTAL U.S.

1932-1982

	Population (000)						Annual Growth Rate
	1932	1942	1952	1962	1972	1982	
Total U.S.	124,813	134,670	155,687	185,708	209,275	231,529	1.24%
Massachusetts	4,259	4,386	4,650	5,263	5,762	5,781	0.61%
Connecticut	1,637	1,798	2,081	2,647	3,070	3,153	1.32%

Source: State Personal Income: 1929-1982, U.S. Dept. of Commerce, February 1984.

greatest in the Fairfield County area located in southern Connecticut. For the three counties focused on for this study--Hartford County in Connecticut and Hampden and Hampshire in Massachusetts--growth has been much slower than in the United States as a whole.

During the 15 years between 1967 and 1982, population in the study area counties increased at a much slower pace than in the nation as a whole, as shown in Exhibit 29. From an industrial perspective, the region's slower population growth indicates that transportation demand for consumer goods will be lower than that experienced in the nation at large.

In Hartford County, from 1967 to 1984, the population increased from 793,000 to 830,000 and is projected to keep increasing through 1995 to 918,000. Larger by itself than Hampden and Hampshire Counties together, Hartford's share of the national population was 0.40 percent in 1967, declined steadily through 1983 to 0.35 percent but is now growing and is projected to retain its share of U.S. population at 0.35 percent as its population grows to 918,000 in 1995.

B.1.2. Labor Force Data

The labor force that is available in Springfield, West Springfield, Chicopee, and Holyoke has remained fairly stable between the years 1975 and 1984 as shown in Exhibit 30. The unemployment rate decreased sharply in each of the towns from 12.9 percent to 5.2 percent in Chicopee, and 14.2 percent to 6.3 percent in Holyoke. During this period, the towns reflected the employment pattern of the counties with manufacturing employment decreasing and non-manufacturing employment increasing.

In Hartford the labor force increased significantly from 68,000 in 1975 to 78,000 in 1984. Unemployment decreased nearly by half over that period, from 11.9 percent to 6.5 percent.

B.1.3. Hampden and Hampshire Counties

Economic conditions in the Massachusetts counties range from concentrated and heavily developed to dispersed and rural. This portion of the region retains an industrial base which originated in manufacturing sectors that are generations old, including fabricated metal products, paper and stationery products, printing and publishing, machinery, sporting goods, and games. The diverse manufacturing economy has contributed to the economic stability of the area over an extended period.

Exhibit 29

POPULATION GROWTH OF STUDY AREA
COUNTIES AND THE TOTAL U.S.

	Population (000)				Annual Growth Rate
	1967	1972	1977	1982	
Total U.S.	197,329	209,364	219,324	231,529	1.07%
Hartford County	793	821	806	811	0.15%
Hampden/Hampshire Counties	585	593	487	644	0.64%

Source: Regional Economic Models, Inc.

Exhibit 30

LABOR FORCE, EMPLOYMENT, AND UNEMPLOYMENT
IN PRINCIPAL COMMUNITIES IN STUDY AREA

	1975	1984
Springfield		
Labor Force	77,284	74,277
Number Employed	67,298	69,450
Number Unemployed	9,986	4,827
Employment Rate	12.9%	6.5%
West Springfield		
Labor Force	14,289	15,638
Number Employed	12,684	15,091
Number Unemployed	1,605	547
Employment Rate	11.2%	3.5%
Chicopee		
Labor Force	29,019	30,074
Number Employed	25,471	28,523
Number Unemployed	3,548	1,551
Employment Rate	12.2%	5.2%
Holyoke		
Labor Force	23,343	20,516
Number Employed	20,022	19,215
Number Unemployed	3,321	1,301
Employment Rate	14.2%	6.3%
Hartford		
Labor Force	68,066	77,827
Number Employed	59,988	72,743
Number Unemployed	8,078	5,085
Employment Rate	11.9%	6.5%

Source: U.S. Department of Commerce, Bureau of the Census.

In recent decades in the Massachusetts counties, the proportion of employment in non-manufacturing sectors has grown. Today, more than twice as many people are working in these sectors--including insurance, finance, education, business services and trade--as in the manufacturing sectors.

Western Massachusetts workers earn wages below that of the national averages in nearly every sector of the economy, whether these workers are building, operating, or repairing machines or servicing clients and customers.

The general trends in the local economy indicate that while a few of the mature or traditional industries will remain strong, relatively higher growth is expected in the non-manufacturing sector, including education, the medical profession, and retail and food occupations. High tech will play a modest role in this part of Massachusetts, while tourism is expected to be a strong component.

B.1.4. Hartford County

Hartford County also has the history of a diversified economy with some of the same industrial characteristics as the Massachusetts counties, including production of fabricated metals, machinery, and electrical equipment. Two of its strongest sectors, however, are uncharacteristic of the Massachusetts area: the aircraft industry--which includes aircraft manufacturing, aircraft engine and aircraft parts manufacturing--and the insurance industry.

In recent years, the Hartford area's economy has been similar to that of the Massachusetts counties in its loss of manufacturing industries, especially of durable goods, and its increase in service producing industries.

The general trend of the Hartford area economy is similar to that of the Western Massachusetts area. Traditional manufacturing industries have first declined, then stabilized in recent years and are projected to experience some growth. The non-manufacturing sector has asserted its dominance in the economy and the labor force--a dominance which it is expected to maintain for the foreseeable future.

B.1.5. Income

One indicator of the economic health of a region is its personal income as shown in the historical demographic and

economic data tabulated in Appendix B. Total personal income in Hampden and Hampshire counties rose steadily, from $1.83 billion in 1967 to $5.82 billion in 1984 and is projected to rise to $12.24 billion in 1995. In 1967, per capita income in Hampden and Hampshire counties was $3,200 (in current dollars). This figure increased to $9,888 by 1984 and is projected to reach $19,016 by 1995. Although this indicated a steadily increasing level of prosperity, the area's real disposable income (RDI) has been shrinking over time relative to the United States as a whole. In 1967 the region's RDI, as a percentage of the nation, was 0.293 percent. By 1984, it had dropped to 0.231 percent and is predicted to continue falling steadily to 0.225 percent in 1995.

In Hartford County in 1967, total personal income was measured at $3.28 billion in current dollars; at $13.28 billion in 1984; and is projected to reach $25.04 billion by 1995. In 1967, the per capita income in Hartford County was $3,542. By 1984 that figure had increased to $13,623 and is predicted to reach $27,272 by 1995. During the period 1967 through 1977, Hartford's share of real disposable income decreased from 0.52 percent to 0.43 percent compared to the rest of the nation. Since 1970, however, it increased to 0.45 percent in 1984 and to a projected 0.45 percent by 1995.

B.2 INDUSTRIAL TRENDS

Industrial trends are described in Appendix B and summarized below in terms of employment, local versus export consumption, and supply/demand balance. The most significant economic indicators to this study, reported by Regional Economic Models, Inc., in Appendix B are: (1) employment; (2) self-supply: local production for local use; (3) export share of U.S. as a percent; and (4) the supply/demand ratio.

B.2.1. Employment

Employment is a key indicator of industrial activity. By examining the sectors in which people have been employed and are expected to be employed in the future, we can see what types of industries are expanding or shrinking and, thus, what types of commodity flows can be expected.

Between 1967 and 1982, significant shifts took place in employment within the study area as shown in Exhibit 31. Manufacturing jobs declined as a percentage of total employment. In

Exhibit 31

CHANGE IN EMPLOYMENT BY SECTOR IN
STUDY AREA COUNTIES

1967 and 1982

	1967		1982	
	Employment	Percentage of Total Employment	Employment	Percentage of Total Employment
Hartford County				
Manufacturing	151,316	44.5%	121,352	29.1%
Durables	135,228	39.7	102,062	24.5
Non-Durables	16,088	4.7	19,290	4.6
Non-Manufacturing	189,030	55.5	295,520	70.9
Services	52,166	15.3	96,032	23.0
Retail Trade	50,918	15.0	69,898	16.8
Finance/Insurance	39,523	11.6	70,203	16.8
Other	46,431	13.6	59,307	14.3
Total	340,354	100.0%	416,872	100.0%
Hampden/Hampshire Counties				
Manufacturing	75,520	42.7%	57,713	30.5%
Durables	39,041	22.1	31,146	16.5
Non-Durables	36,479	20.6	26,567	14.0
Non-Manufacturing	101,417	57.3	131,431	69.5
Services	34,033	19.2	52,439	27.7
Retail Trade	32,619	18.4	39,456	20.9
Finances/Insurance	9,633	5.4	13,431	7.1
Other	35,132	14.3	26,105	14.5
Total	176,937	100.0%	189,144	100.0%

Source: Regional Economic Models, Inc.

Hartford County, manufacturing employment declined from 44.5 percent of all employment in 1967 to 29.1 percent of all employment in 1982. Employment in durables manufacturing in Hartford County accounted for the decline with employment declining in absolute terms.

B.2.1.1. Manufacturing vs. Non-Manufacturing

Hartford County had 151,300 people employed in the manufacturing sector in 1967, and 189,000 people in the non-manufacturing sector. By 1983, manufacturing had slumped to 118,400, while non-manufacturing was up to 302,400. In 1984 manufacturing increased by 4,500 jobs and non-manufacturing increased by 12,000. Both sectors are projected to experience growth with employment in manufacturing reaching 138,000 and in non-manufacturing reaching 424,400 by 1995.

In Hampden and Hampshire counties, manufacturing employment also declined as a percentage of total employment (from 42.7 percent to 30.5 percent) and in absolute terms. In Hampden and Hampshire counties, 75,500 people were employed in the manufacturing sector and 101,400 in the non-manufacturing sector in 1967. Employment in the manufacturing sector declined steadily to 54,950 in 1983, while non-manufacturing employment increased to 131,570. In 1984, employment in both sectors began to increase and projections indicated that by 1995 manufacturing will employ about 64,700 people and non-manufacturing 176,500.

As manufacturing jobs declined, non-manufacturing jobs, especially in the services, retail trade and finance/insurance real estate sectors registered significant increases.

B.2.1.2. Manufacturing Industries

Within the manufacturing sector itself, significant changes in employment also occurred by industry. As shown in Exhibit 32, in Hartford County employment in transportation equipment and non-electrical machinery manufacturing declined while employment in printing and instrument manufacturing increased.

Fabricated metals, which employed 26,600 people in 1967 declined to 20,000 in 1983, but with 21,000 employed in 1984 is expected to increase to 25,800 by 1995. Non-electrical machinery manufacturing experienced a similar trend and is also projected

Exhibit 32

DISTRIBUTION OF MANUFACTURING EMPLOYMENT
BY INDUSTRY SECTOR WITHIN STUDY AREA COUNTIES

	1967		1982	
	Jobs	Percent of Total	Jobs	Percent of Total
Hartford County				
Transportation Equipment	48,405	32.0%	35,608	29.3%
Non-Electrical Machinery	37,289	24.6	25,510	21.0
Fabricated Metal	26,581	17.6	20,951	17.3
Electrical Equipment	10,847	7.2	9,958	8.2
Primary Metals	4,514	3.0	2,649	2.2
Printing	4,004	2.6	6,413	5.3
Instruments	3,382	2.2	4,257	3.5
Other	16,294	10.8	16,006	13.2
Total	151,316	100.0%	121,352	100.0%
Hampden/Hampshire Counties				
Fabricated Metal	14,107	18.7%	9,356	16.2%
Paper	10,082	13.4	7,164	12.4
Non-Electrical Machinery	8,395	11.1	9,405	16.3
Printing	6,158	8.2	6,300	10.9
Rubber	4,307	5.7	3,396	5.9
Food	3,890	5.2	2,506	4.3
Primary Metals	3,741	5.0	2,109	3.7
Textiles	2,826	3.7	1,567	2.7
Apparel	3,010	4.0	2,039	3.5
Chemicals	3,045	4.0	2,881	5.0
Other	15,858	21.1	10,990	19.0
Total	75,520	100.0%	57,713	100.0%

Source: Regional Economic Models, Inc.

to expand over the next ten years. Electrical equipment, employing about 11,000 in 1967 experienced a slight decline, but is projected to grow to nearly 13,000 by 1995. Transportation equipment other than motor vehicles (primarily aircraft) which employed 48,400 in 1967, experienced a sharp decline in 1972-1977 to about 30,700 and is projected to fluctuate slightly above its current number of 35,500 between 1984 and 1995. In the non-manufacturing sector, the region houses industries which are growing nationally. These industries are the finance, insurance and real estate sector which, although growing slower in Hartford County than the rest of the country, employed 31,500 people in 1967, increased to a current level of 55,500 and is projected to take the lead for all types of employment at 70,800 by 1995. Miscellaneous business services experienced rapidly increasing employment, from 7,000 employees in 1967 to 23,700 in 1984 and is projected to employ nearly 40,000 by 1995. Medical services also experienced significant growth, employing 11,500 in 1967, 33,800 in 1984 and projected to reach 49,000 by 1995.

Similarly, in Hampden and Hampshire counties, employment in fabricated metals, paper, food, primary metals, and textiles declined while employment in non-electrical machinery, printing and chemicals increased.

Fabricated metal and paper production, which formerly employed large numbers of workers, declined significantly since 1967. According to the REMI economic projections, employment in the fabricated metal industry will increase slightly by 1995 and employment in paper manufacture will stabilize. Non-electric machinery, which has had a consistently strong employment pattern, is projected to experience strong growth through 1995.

Although these trends do not, in themselves, indicate a greater or lesser demand for freight transportation, it appears that manufacturing in the study area has been trending away from the industries that require transportation of large volumes of raw materials toward industries that require higher-valued intermediate components.

B.2.2. Local Consumption Versus Export

One measure of transportation demand is the degree to which manufacturers export finished goods from the region rather than selling them for local consumption. The comparison of local production for local use to local production for export impacts transportation activity in a region. If production for export is increasing, a corresponding increase in transportation can be expected. In this regard, manufacturers within the area have

increased the percentage of their output shipped outside the area in only a few industries, as shown in Exhibit 33. In Hartford County, only the printing industry significantly increased the percentage of its output shipped outside the region. In Hampden and Hampshire Counties, no industry registered a significant increase but non-electrical machinery and chemicals did register very slight increases.

B.2.3. Supply/Demand Balance

Another measure of transportation demand is the ratio of the supply of a particular product versus the demand for that product in the region. If supply exceeds intra-regional demand, the industry is a net exporter. Conversely, if demand exceeds the supply produced within the region, the industry will be a net importer. As shown in Exhibit 34, in Hartford County four industries--transportation equipment, fabricated metals, non-electrical machinery and instruments--were net exporters. All others were net importers. Of these, a number, such as tobacco, chemicals and food, experienced significant increases in the supply/demand ratio indicating that imports to the region had declined and, consequently, that demand for transportation also had likely declined.

In Hampden and Hampshire Counties, as shown in Exhibit 35, net importing and exporting industries were more balanced than in Hartford County. Notable among the net exporting industries was tobacco manufacturing, which changed from a net export position in 1967 (supply/demand ration of 211.5) to a net importing position in 1982 (supply/demand ratio of 9.4). Non-electrical machinery was the only net exporting industry that significantly increased its supply/demand balance during the period, from 149.4 in 1967 to 196.0 in 1982.

Among the net importing industries, furniture and food had significant decreases in the supply/demand ratios, indicating an increased requirement for imports, and petroleum products, transportation equipment, instruments, store and clay, and electrical equipment all had significant increases, indicating a reduced requirement for imports.

B.2.4. Land Use

The amount of land that is used for various purposes is displayed in Exhibit 36 (for Hamden and Hampshires Counties and for the Connecticut Capital Region as a surrogate for Hartford County. In the Massachusetts counties, comercial use at 1.0

Exhibit 33

CHANGE IN PERCENTAGE OF MANUFACTURING
OUTPUT SHIPPED OUTSIDE STUDY AREA

1967-1982

	1967	1982
Hartford County		
Transportation Equipment	96.0%	96.1%
Non-Electrical Machinery	90.9	89.0
Fabricated Metal	97.2	97.4
Electrical Equipment	98.9	99.1
Primary Metals	92.1	92.5
Printing	32.6	44.0
Instruments	99.4%	99.4%
Hampden/Hampshire Counties		
Fabricated Metals	92.8%	92.5%
Paper	95.1	94.9
Non-Electrical Machinery	91.6	93.6
Printing	76.6	76.7
Rubber	96.0	94.9
Food	87.3	85.4
Primary Metals	94.5	94.7
Textiles	93.5	93.2
Apparel	94.6	94.6
Chemicals	93.0%	93.9%

Exhibit 34

CHANGE IN SUPPLY/DEMAND RATIO
BY INDUSTRY WITHIN HARTFORD COUNTY

1967-1982

	Supply/Demand Ratio	
	1967	1982
Net Exporting Industries		
Transportation Equipment	424.9%	444.9%
Fabricated Metals	268.6	284.9
Non-Electrical Machinery	231.9	193.2
Instruments	131.1	126.7
Net Importing Industries		
Motor Vehicles	0.9%	1.0%
Leather	1.6	1.0
Tobacco Manufacturing	19.9	63.7
Lumber	27.1	24.9
Textiles	30.5	28.3
Chemicals	32.7	60.8
Primary Metals	33.7	35.4
Petroleum Products	35.7	30.3
Furniture	36.8	36.6
Stone, Clay, etc.	42.5	44.3
Food	44.9	56.2
Apparel	46.2	46.6
Rubber	67.0	54.6

Exhibit 35

CHANGE IN SUPPLY/DEMAND RATIO
BY INDUSTRY WITHIN HAMPDEN/HAMPSHIRE COUNTIES

1967-1982

	Supply/Demand Ratio	
	1967	1982
Net Exporting Industries		
Miscellaneous Manufacturing	411.7%	404.4%
Fabricated Metal	352.5	339.7
Rubber	237.1	185.1
Tobacco Manufacturing	211.5	9.4
Paper	209.8	201.1
Printing	150.8	151.5
Non-Electrical Machinery	144.4	196.0
Leather	146.7	121.9
Textiles	106.6	102.9
Net Importing Industries		
Motor Vehicles	3.2%	2.7%
Petroleum Products	3.6	7.9
Furniture	24.8	18.3
Transportation Equipment	34.7	73.6
Lumber	38.1	40.7
Instruments	42.9	59.7
Stone, Clay, etc.	46.5	58.8
Electrical Equipment	55.0	66.9
Primary Metals	59.3	61.0
Food	78.5	68.2
Apparel	78.6	79.1
Chemical	79.6	90.9

Exhibit 36

LAND USE

	Hamden and Hampshire Counties[1]		Connecticut Capital Region[2]	
Land Use Category	Acres	Percent	Acres	Percent
Residential	105,160	13.9%	94,063	19.3%
Commercial	7,710	1.0	7,334	1.5
Industrial	14,900	2.0	8,404	1.7
Agricultural	53,676	7.1	82,943	17.0
Government	18,260	2.4	-	-
Institutional	-	-	7,708	1.6
Open or Recreational	140,939	18.7	22,243	4.6
Water	23,192	3.1	10,613	2.2
Undeveloped	-	-	254,359	52.2
Unclassified	390,541	51.8	-	-
TOTAL	754,378	100.0%	487,667	100.0%

[1]Source: Pioneer Valley Planning Commission; Base Data Report, 1984.
[2]Source: Capital Region Council of Governments.

percent and industrial use at 2.0 percent show a residential, agricultural, and undeveloped economy. For the Connecticut area, commercial use at 1.5 percent and industrial use at 1.7 percent show a similar type of economy.

B.2.5. Summary of Industrial Trends

The industrial trends observed for the study area for the period 1967 through 1982 indicate the following:

- Population within the study area has increased at a significantly slower annual rate (0.36 percent) than in the United States as a whole (1.07 percent).
- Employment shifted away from manufacturing toward the service sector.
- Employment in durables manufacturing decreased both in absolute terms and as a percentage of total employment within the study area.
- Manufacturing within the study area has been trending away from industries that require transportation of large volumes of bulk raw materials toward industries that use higher-value intermediate inputs.
- With the single exception of the printing industry in Hartford County, no industry in the study area significantly increased the percentage of its output that is exported from the region. However, this is partially caused by the high percentage of output already exported from the region by many industries as a result of the relatively small local consuming market.
- In general, transportation demand declined during the period for raw materials and heavy manufactures and increased for consumer goods and higher-value intermediate manufactures.

C. POTENTIAL USERS

Potential users of the improved waterway were identified by first finding the names of all manufacturing and service organizations in the study area and then screening out the least likely users. These steps are described below.

C.1 COMPANIES IN THE STUDY AREA

In order to identify all companies and public institutions in the study area, a number of sources were used. The primary sources were a series of four directories that are published by the George D. Hall Company in conjunction with The Associated Industries of Massachusetts and The Connecticut Business and Industry Association. A Directory of Manufacturers and a Service Directory are published for each state.

Companies were listed by town in each directory. Each company is shown with address, phone number, manager's names, number of employees, gross sales, SIC code and product or service. Additional sources of information were used to verify completeness of the lists. These included:

- Directory of 51,000 Largest U.S. Corporations, Ward's
- Million Dollar Directory, 1984, Dun & Bradstreet, Inc.
- Inventory of Employers of 250 or More in the Pioneer Valley Region, Pioneer Valley Planning Commission.

In addition, lists of universities, colleges, hospitals, and public agencies were assembled from interviews with members of regional planning organizations.

The master list was augmented during the qualification telephone survey, as described below, when additional potential shippers were identified by respondents.

C.2 POTENTIAL USERS

The potential users were determined through a screening process that eliminated companies and institutions with limited potential for using barge transportation.

The screening criteria used related to the type of business or activity engaged in and the size of the operation. The type of business, identified by SIC code and product or service provided, provided information about the kinds of freight transportation it was required. High potential business types included:

- Bulk or neobulk commodity consumers;
- Bulk or neobulk commodity producers;
- Importers; and
- Exporters.

The commodities that were considered to be most appropriate for river transportation included:

- Liquid bulk
  - --Petroleum products
  - --Fertilizer
- Dry bulk
  - --Coal
  - --Ores and minerals
  - --Grain
  - --Fertilizer
  - --Sand and gravel
  - --Cement
- Neo-bulk
  - --Steel
  - --Lumber
  - --Scrap metal
  - --Waste materials

- Containerized

  --Consumer products

  --Intermediate manufactures

  --Raw materials

The principal size criterion used was gross annual sales. However, the number of employees also was considered as an additional criterion. The annual sales figure was used in conjunction with the type of potential shipments as follows:

- If bulk user, included if annual sales were greater than $1 million.
- If neobulk user, included if sales were greater than $10 million.
- If importer or exporter, included if sales were greater than $10 million.

In addition, a sample of 25 percent of importers and exporters with sales from $1 to $10 million also was reviewed.

The screening process produced a list of 490 potential users. A total of 115 other potential users was added to the list as additional information was collected from respondents to the qualification telephone survey. The expanded list of 605 qualified potential users is shown in Exhibit 37, arranged by SIC codes.

Exhibit 37

SUMMARY OF SCREENED LIST OF POTENTIAL USERS

SIC Code	SIC Name	Number of Establishments	
		Conn.	Mass.
07	Agricultural Services	1	0
15	Building Construction	0	1
16	Construction Other Than Building	0	1
17	Construction-Special Trade Contractors	5	1
20	Food and Kindred Products	2	2
21	Tobacco Manufacturers	1	0
22	Textile Mill Products	2	2
23	Apparel and Other Fabric Products	2	0
24	Lumber and Wood Products	2	5
25	Furniture and Fixtures	1	2
26	Paper and Allied Products	6	26
27	Printing, Publishing, and Allied Industries	9	17
28	Chemicals and Allied Products	7	10
29	Petroleum Refining and Related Industries	0	3
30	Rubber and Miscellaneous Plastics Products	8	16
31	Leather and Leather Products	0	2
32	Stone, Clay, Glass, and Concrete Products	8	7
33	Primary Metal Industries	9	11
34	Fabricated Metal Products	35	27
35	Machinery, Except Electrical	47	33
36	Electrical and Electronic, Machinery, Equipment and Supplies	17	8
37	Transportation Equipment	10	5
38	Measuring, Analyzing, etc. Instruments	7	6
39	Miscellaneous Manufacturing Industries	6	9
41	Local Transit Passenger Transportation	0	9
42	Motor Freight Transportation and Warehousing	16	14
45	Transportation by Air	2	1
49	Electric, Gas, and Sanitary Services	13	4
50	Wholesale Trade, Durable Goods	36	20
51	Whole Trade, Nondurable Goods	10	16
52	Retail Trade, Building Materials, etc.	3	8
53	Retail Trade, Department Stores	1	0
55	Retail Trade, Automotive Dealers	1	0
59	Miscellaneous Retail	4	15
73	Business Services	0	2
80	Health Services	11	12
82	Educational Services	9	9
Unknown	Unknown	4	6
	Total (605)	295	310

D. TRANSPORTATION RATES

This section of the report describes freight rates for transportation of commodities into and out of the study area. Rates for tug and barge transportation were estimated using TBS's Tug-Barge Waterways Costing Model (TBWCM) and verified by carriers. Though self-propelled tankers are on use on the lower portion of the Connecticut River, their draft requirements will preclude economic operation north of Hartford. Rates for pipeline, railroad, and truck were developed from tariffs, TBS in-house data files, and industry sources.

D.1 WATERWAY RATES

The rates for water transportation on the Connecticut River to Holyoke were determined with the use of the TBWCM. The input variables and the structure of the model used in this application were verified through discussions with tug and barge operators who now serve the Connecticut River below Hartford. The following sections describe the model's use, its structure and variables, model results, and the verification procedure.

D.1.1 The Tug-Barge Waterways Costing Model

The TBWCM was designed to calculate a Required Freight Rate (RFR), which is the rate required to allow the carrier to recover all costs of transportation. The RFR includes all elements of the move including prior truck or rail shipment costs between the origin and the loading terminal, loading costs, linehaul costs, delay costs, locking time costs, unloading costs, storage costs and any subsequent truck or rail shipment from the discharge terminal to the destination. Costs were developed on a daily basis and then expanded to cover the total time for the voyage. Minor variations were programmed into the model to accommodate the following types of barges and commodities:

- Tank barges for clean petroleum products and chemicals, such as No. 2 distillate oil, gasoline, and lubricating oils;
- Coiled tank barges with heating coils for dirty petroleum products, such as No. 4 and No. 6 residual oil;
- Double skin tank barges for chemicals requiring additional protection

- Open hopper barges for coal, scrap metal, and other bulk and neobulk commodities; and

- Deck barges for containers.

As the costs were developed, particular attention was given to selecting the lowest available cost when alternative cost structures were identified. For example, daily labor costs for a six person tugboat crew vary from $2,200 for a Local No. 33, International Longshoremen's Association (ILA) union crew to $1,205 for a Seamen's International Union of North America (SIUNA) union crew to $800 for a non-union crew. For the purpose of this analysis, the low-cost non-union crew was selected. The intention was to insure that all cost savings available to tugboat operators were reflected in the model.

Another example of an area where significant variances existed was in the valuation of used tugboats to establish current market prices. In this area and in other areas where a range of costs existed, the lowest cost alternative was selected for inclusion in the model.

The results of the model simulations are shown below in Exhibits 38 to 44. Upon receipt of origin/destination data from shippers in Part III of this study, the model will be run again to include all potential movements on the Connecticut River above Hartford.

D.1.2 Model Description

This section provides a brief description of each of the TBWCM's input and output variables. Exhibit 38 is an example of the TBWCM applied to a tank barge carrying clean products (No. 2 fuel oil) inbound on the Connecticut River. Four voyages were modelled. Two originating in New York and two in New Haven. Costs of service from both of these origins to Holyoke and Springfield were determined.

The vessel input variables are shown on the first page. Variables are shown separately for the tug and barge. The trade route description, voyage performance calculations, and voyage cost calculations are shown on the second page.

The following sections provide brief descriptions of the variables and the assumptions used.

D.1.2.1 Tug Operating Characteristics

For the tug, the operating characteristics are shown for the necessary horsepower vessel operating at various speeds.

Exhibit 38

TANK BARGE- CLEAN PRODUCTS
TUG BARGE WATERWAYS COST MODEL

	INBOUND						
INPUTS	NEW YORK HOLYOKE	NEW YORK SPRINGFIELD	NEW HAVEN HOLYOKE	NEW HAVEN SPRINGFIELD	NEW HAVEN AMHERST	NEW HAVEN E. HAMPTON	ROCKY HILL E. HAMPTON
TUG							
VESSEL SIZE(HORSEPOWER)	1700	1700	1700	1700	1700	1700	1700
VESSEL SPEED(KNOTS)							
LIGHT-RIVER	8.0	8.0	8.0	8.0	8.0	8.0	8.0
LIGHT-BAYS AND SOUNDS	8.0	8.0	8.0	8.0	8.0	8.0	8.0
LOADED-RIVERS	6.0	6.0	6.0	6.0	6.0	6.0	6.0
LOADED-BAYS AND SOUNDS	6.0	6.0	6.0	6.0	6.0	6.0	6.0
CAPITAL COST							
PRINCIPAL AMOUNT ($)	600000	600000	600000	600000	600000	600000	600000
INTEREST RATE (%)	.12	.12	.12	.12	.12	.12	.12
NUMBER OF PERIODS (YEARS)	20	20	20	20	20	20	20
DAILY CAPITAL COST ($)	220	220	220	220	220	220	220
DAILY OPERATING COSTS ($)	1430	1430	1430	1430	1430	1430	1430
DAILY OVERHEAD ($)	248	248	248	248	248	248	248
DAILY PROFIT ($)	165	165	165	165	165	165	165
DAILY TUG COST ($)	2063	2063	2063	2063	2063	2063	2063
LUBE OIL CONSUMPTION(GAL/DAY)							
LIGHT-RIVERS	7.7	7.7	7.7	7.7	7.7	7.7	7.7
LIGHT-BAYS AND SOUNDS	7.7	7.7	7.7	7.7	7.7	7.7	7.7
LOADED	9.2	9.2	9.2	9.2	9.2	9.2	9.2
MAIN ENG FUEL CONS(GAL/DAY)							
LIGHT-RIVERS	1469	1469	1469	1469	1469	1469	1469
LIGHT-BAYS AND SOUNDS	1469	1469	1469	1469	1469	1469	1469
LOADED	1763	1763	1763	1763	1763	1763	1763
GENERATOR FUEL CONS(GAL/DAY)							
TUG-MAIN GENERATOR	150	150	150	150	150	150	150
BARGE-MAIN GENERATOR	261	270	347	362	347	347	347
ANNUAL OPERATING DAYS	350	350	350	350	350	350	350
BARGE							
DEADWEIGHT (TONS)	5500	5500	5500	5500	5500	5500	5500
CARGO CAPACITY							
FULLY LOADED (TONS)	3800	3800	3800	3800	3800	3800	3800
CAPITAL COST							
PRINCIPAL AMOUNT ($)	1500000	1500000	1500000	1500000	1500000	1500000	1500000
INTEREST RATE (%)	.12	.12	.12	.12	.12	.12	.12
NUMBER OF PERIODS (YEARS)	20	20	20	20	20	20	20
DAILY CAPITAL COST ($)	550	550	550	550	550	550	550
DAILY OPERATING COST ($)	330	330	330	330	330	330	330
DAILY OVERHEAD ($)	88	88	88	88	88	88	88
DAILY PROFIT ($)	44	44	44	44	44	44	44
DAILY BARGE COST ($)	1012	1012	1012	1012	1012	1012	1012

Exhibit 38 (continued)

TANK BARGE- CLEAN PRODUCTS
TUG BARGE WATERWAYS COST MODEL

TRADE ROUTE							
LOADING PORT	NEW YORK	NEW YORK	NEW HAVEN	NEW HAVEN	NEW HAVEN	NEW HAVEN	ROCKY HILL
DISCHARGING PORT	HOLYOKE	SPRINGFIELD	HOLYOKE	SPRINGFIELD	HOLYOKE	HOLYOKE	HOLYOKE
ONE WAY DISTANCE (MILES)							
RIVERS	84	77	84	77	84	84	42
BAYS AND SOUNDS	79	79	22	22	22	22	0
PILOTAGE COST ($)	200	200	200	200	200	200	200
LOAD PORT COSTS ($)	0	0	0	0	0	0	0
DISCHARGE PORT COSTS ($)	0	0	0	0	0	0	0
TRUCKING COST ($)	0	0	0	0	12312	4039	4039
OTHER ASSUMPTIONS							
DIESEL FUEL OIL COST/GAL ($)	.85	.85	.85	.85	.85	.85	.85
LUBE OIL COST/GAL ($)	3.50	3.50	3.50	3.50	3.50	3.50	3.50
OUTPUTS							
VOYAGE PERFORMANCE							
CARGO PER VOYAGE (TONS)	3800	3800	3800	3800	3800	3800	3800
TIME UNDERWAY(DAYS)							
RIVERS	1.02	.94	1.02	.94	1.02	1.02	.51
BAYS AND SOUNDS	.96	.96	.27	.27	.27	.27	.00
LOAD PORT TIME (DAYS)	.33	.33	.33	.33	.33	.33	.33
DISCHARGE PORT TIME (DAYS)	.33	.33	.33	.33	.33	.33	.33
LOCK DELAYS (DAYS)	.17	.17	.17	.17	.17	.17	.17
TOTAL VOYAGE TIME (DAYS)	2.81	2.73	2.12	2.03	2.12	2.12	1.34
VOYAGE COST ($)							
CAPITAL COSTS PER VOYAGE							
TUG	619	600	466	447	466	466	295
BARGE	1547	1500	1165	1119	1165	1165	737
OPERATING COSTS PER VOYAGE							
TUG	4020	3858	3029	2907	3029	3029	1917
BARGE	900	900	699	671	699	699	442
OVERHEAD COST PER VOYAGE	356	345	268	257	268	268	170
PROFIT PER VOYAGE	356	345	268	257	268	268	170
MAIN ENGINE FUEL COST/VOY.	2756	2638	1792	1674	1792	1792	710
LUBE OIL COST/VOY.	59	57	39	36	39	39	15
GENERATOR FUEL COST/VOY	983	972	895	884	895	895	566
PILOTAGE COST PER VOYAGE	400	400	400	400	400	400	400
PORT CHARGES PER VOYAGE	0	0	0	0	0	0	0
TRUCKING COST	0	0	0	0	12312	4039	4039
TOTAL VOYAGE COSTS	12022	11634	9021	8653	21333	13060	9462
REQUIRED FREIGHT RATE ($)							
FIXED(CAP.,O.HEAD,PROFIT)	.76	.73	.57	.55	.57	.57	.36
VARIABLE							
OPERATING	1.30	1.26	.98	.94	.98	.98	.62
VOYAGE	1.10	1.07	.82	.79	4.06	1.89	1.51
SUBTOTAL VARIABLE	2.41	2.33	1.80	1.73	5.04	2.87	2.13
TOTAL REQUIRED FREIGHT RATE($)	3.16	3.07	2.37	2.28	5.61	3.44	2.49

- Horsepower--A tug with 1,700 horsepower is sufficient to provide the motive power necessary to navigate the inland coastal waterways and the Connecticut River. More power could be used--especially to improve steerage when downbound on the river--but would result in excessive fuel costs.

- Speed--The top speed of 6.0 knots when loaded increases to 8.0 knots when the barge is empty.

D.1.2.2 Tug Costs

Tug costs includes the capital cost, operating costs, overhead, profit, and fuel cost--all calculated for 365 operating days per year:

- Capital cost--The capital cost was based on financing a used but fully operational tugboat with a price of $600,000 at 12 percent interest over a 20-year period. Tugs are currently available at this price in the New York area.

- Operating costs--The daily tug operating cost of $1,430 includes wages and benefits ($800); subsistence to feed the crew ($63); stores, supplies, and equipment ($120); maintenance and repair ($344); and insurance ($103). These costs are based on Maritime Administration cost analyses, except for the labor costs which were provided by a towing company.

- Overhead and profit--The overhead, which covers shoreside support for the vessel, was calculated at 15 percent of the sum of the daily capital and operating costs. Daily profit was calculated at 10 percent of the same amount. The rates are representative of industry experience.

- Fuel consumption--Fuel consumption for the main engine was calculated at 0.48 gallons per horsepower-hour at 90 percent of full power when towing loaded and at 75 percent when towing light. Electric generator fuel consumption for a tug of this size was estimated at 150 gallons per operating day. To provide pumping capacity for unloading the barge, the fuel necessary for a generator on the barge was included. Its consumption for the tug was calculated at 735 gallons for

discharging a full cargo. Since the costs are calculated on a daily basis, the barge generator daily cost will vary depending upon the length of each trip. Lubricating oil consumption was calculated at a standard 0.0025 gallons per horsepower-hour when underway.

- Operating days--Annual operating days were assumed to be 350 days, permitting 15 days for out of service maintenance. Since area tug operators often experience less than 300 operating days per year, the 350 days yields the lowest possible daily capital cost by allocating the fixed costs over the maximum possible number of days.

D.1.2.3 Barge Costs

Barge capacity for No. 2 fuel oil was set at 25,000 barrels or 3,800 short tons. This cargo capacity is less than the barge's deadweight tonnage because fuel oil is lighter than water and the volumetric limit is reached before the weight limit.

- Capital cost--The lowest cost for a new barge was 1.5 million dollars. New barges were selected because there is little excess capacity available in existing barges operating on the Connecticut River that could serve the upper Connecticut River.

- Operating costs--Daily operating costs included $130 for supplies, maintenance, and repair and $100 for insurance.

- Overhead and profit--The overhead and profit were calculated at 10 and 5 percent, respectively, of the sum of the daily capital and operating costs. These are typical of industry experience.

D.1.2.4 Trade Route

The trade route was described in terms of the distance in nautical miles on the river and on the bays and sounds. Pilotage cost on the Connecticut River was approximately $200 each way. Port loading costs for fuel oil was excluded because it is incurred equally by the shipper with all modes of transport. Unloading cost was accounted for in the barge generator fuel expense as described previously. Truck and rail costs for the cost of prior and subsequent moves to the loading terminal and from the discharge terminal are included. All voyages are calculated with empty backhauls.

D.1.2.5 Other Assumptions

Costs of diesel fuel consumed by the main propulsion plant and generators, as well as the lubricating oil cost are shown at current market prices of $0.85 and $3.50 per gallon, respectively.

D.1.2.6 Voyage Performance

The next section of Exhibit 38 displays the voyage performance statistics. The distances were divided by speeds to determine the times underway in the river and in open water of the bays and sounds. Time spent loading, discharging, and at locks were estimated, based on industry experience and added to underway time to produce total voyage time.

The individual voyage line-item costs were determined by multiplying the daily line-item costs and the voyage days. Summing these voyage line-item costs produced the total voyage cost, which then was divided by the amount of cargo carried to produce the RFR per unit of cargo. In the simulations, except those for the deck barge which is used to carry containers, the RFR is presented in dollars per short ton; for the container service operated with the deck barge, the RFR is in dollars per container.

D.1.3 Model Results

In addition to the cost simulation for the inbound tank barge carrying clean products shown in Exhibit 38 and explained above, outbound movements are shown in Exhibit 39. The costs for the tank barge with dirty products inbound is shown in Exhibit 40; there are no outbound dirty products shipments. Exhibit 41 shows the cost for double skin tank barges carrying chemicals inbound. Covered hopper barges are shown in Exhibit 42 for inbound and outbound. Open hopper movements are costed in Exhibit 43 for inbound traffic and Exhibit 44 for outbound. The costs of the deck barge carrying containers is displayed in Exhibit 45 for inbound and Exhibit 46 for outbound.

The results of the TBWCM simulations for all barge types and voyages is summarized in Exhibit 47.

D.1.3.1 Verification Procedure

The results of the model simulations were discussed with representatives of two barge lines that currently serve the Connecticut River. Based on their feedback, the input variables

Exhibit 39

TANK BARGE- CLEAN PRODUCTS
TUG BARGE WATERWAYS COST MODEL

INPUTS	OUTBOUND			
	CHICOPEE NEW YORK	CHICOPEE ELIZABETH	SPRINGFIELD NEW YORK	SPRINGFIELD BOSTON
TUG				
VESSEL SIZE(HORSEPOWER)	1700	1700	1700	1700
VESSEL SPEED(KNOTS)				
LIGHT-RIVER	6.0	6.0	6.0	6.0
LIGHT-BAYS AND SOUNDS	6.0	6.0	6.0	6.0
LOADED-RIVERS	6.0	6.0	6.0	6.0
LOADED-BAYS AND SOUNDS	6.0	6.0	6.0	6.0
CAPITAL COST				
PRINCIPAL AMOUNT ($)	600000	600000	600000	600000
INTEREST RATE (%)	.12	.12	.12	.12
NUMBER OF PERIODS (YEARS)	20	20	20	20
DAILY CAPITAL COST ($)	220	220	220	220
DAILY OPERATING COSTS ($)	1430	1430	1430	1430
DAILY OVERHEAD ($)	248	248	248	248
DAILY PROFIT ($)	165	165	165	165
DAILY TUG COST ($)	2063	2063	2063	2063
LUBE OIL CONSUMPTION(GAL/DAY)				
LIGHT-RIVERS	7.7	7.7	7.7	7.7
LIGHT-BAYS AND SOUNDS	7.7	7.7	7.7	7.7
LOADED	9.2	9.2	9.2	9.2
MAIN ENG FUEL CONS(GAL/DAY)				
LIGHT-RIVERS	1469	1469	1469	1469
LIGHT-BAYS AND SOUNDS	1469	1469	1469	1469
LOADED	1763	1763	1763	1763
GENERATOR FUEL CONS(GAL/DAY)				
TUG-MAIN GENERATOR	150	150	150	150
BARGE-MAIN GENERATOR	255	254	270	212
ANNUAL OPERATING DAYS	350	350	350	350
BARGE				
DEADWEIGHT (TONS)	3500	3500	3500	3500
CARGO CAPACITY				
FULLY LOADED (TONS)	3800	3800	3800	3800
CAPITAL COST				
PRINCIPAL AMOUNT ($)	1500000	1500000	1500000	1500000
INTEREST RATE (%)	.12	.12	.12	.12
NUMBER OF PERIODS (YEARS)	20	20	20	20
DAILY CAPITAL COST ($)	550	550	550	550
DAILY OPERATING COST ($)	330	330	330	330
DAILY OVERHEAD ($)	88	88	88	88
DAILY PROFIT ($)	44	44	44	44
DAILY BARGE COST ($)	1012	1012	1012	1012

Exhibit 39 (continued)

TANK BARGE- CLEAN PRODUCTS
TUG BARGE WATERWAYS COST MODEL

TRADE ROUTE				
LOADING PORT	CHICOPEE	CHICOPEE	SPRINGFIELD	SPRINGFIELD
DISCHARGING PORT	NEW YORK	NEW JERSEY	NEW YORK	BOSTON
ONE WAY DISTANCE (MILES)				
RIVERS	81	81	77	77
BAYS AND SOUNDS	79	89	79	140
PILOTAGE COST ($)	200	200	200	200
LOAD PORT COSTS ($)	0	0	0	0
DISCHARGE PORT COSTS ($)	0	0	0	0
TRUCKING COST ($)	0	0	0	0
OTHER ASSUMPTIONS				
DIESEL FUEL OIL COST/GAL ($)	.85	.85	.85	.85
LUBE OIL COST/GAL ($)	3.50	3.50	3.50	3.50
OUTPUTS				
VOYAGE PERFORMANCE				
CARGO PER VOYAGE (TONS)	3800	3800	3800	3800
TIME UNDERWAY(DAYS)				
RIVERS	.98	.98	.94	.94
BAYS AND SOUNDS	.96	1.08	.96	1.70
LOAD PORT TIME (DAYS)	.33	.33	.33	.33
DISCHARGE PORT TIME (DAYS)	.33	.33	.33	.33
LOCK DELAYS (DAYS)	.17	.17	.17	.17
TOTAL VOYAGE TIME (DAYS)	2.77	2.90	2.73	3.47
VOYAGE COST ($)				
CAPITAL COSTS PER VOYAGE				
TUG	611	637	600	763
BARGE	1526	1593	1500	1908
OPERATING COSTS PER VOYAGE				
TUG	3967	4141	3898	4958
BARGE	916	956	900	1144
OVERHEAD COST PER VOYAGE	351	366	345	439
PROFIT PER VOYAGE	351	366	345	439
MAIN ENGINE FUEL COST/VOY.	2706	2875	2638	3669
LUBE OIL COST/VOY.	58	62	57	79
GENERATOR FUEL COST/VOY	978	994	972	1067
PILOTAGE COST PER VOYAGE	400	400	400	400
PORT CHARGES PER VOYAGE	0	0	0	0
TRUCKING COST	0	0	0	0
TOTAL VOYAGE COSTS	11864	12391	11654	14865
REQUIRED FREIGHT RATE ($)				
FIXED(CAP.,O.HEAD,PROFIT)	.75	.78	.73	.93
VARIABLE				
OPERATING	1.29	1.34	1.26	1.61
VOYAGE	1.09	1.14	1.07	1.37
SUBTOTAL VARIABLE	2.38	2.48	2.33	2.98
TOTAL REQUIRED FREIGHT RATE($)	3.12	3.26	3.07	3.91

Exhibit 40

TANK BARGE- DIRTY PRODUCTS
TUG BARGE WATERWAYS COST MODEL

INPUTS	INBOUND					
	NEW YORK AMHERST	NEW YORK SPRINGFIELD	NEW HAVEN AMHERST	NEW HAVEN SPRINGFIELD	NEW HAVEN BUFFIELD	BOSTON SPRINGFIELD
TUG						
VESSEL SIZE(HORSEPOWER)	1700	1700	1700	1700	1700	1700
VESSEL SPEED(KNOTS)						
LIGHT-RIVER	6.0	6.0	6.0	6.0	6.0	6.0
LIGHT-BAYS AND SOUNDS	6.0	6.0	6.0	6.0	6.0	6.0
LOADED-RIVERS	6.0	6.0	6.0	6.0	6.0	6.0
LOADED-BAYS AND SOUNDS	6.0	6.0	6.0	6.0	6.0	6.0
CAPITAL COST						
PRINCIPAL AMOUNT ($)	600000	600000	600000	600000	600000	600000
INTEREST RATE (%)	.12	.12	.12	.12	.12	.12
NUMBER OF PERIODS (YEARS)	20	20	20	20	20	20
DAILY CAPITAL COST ($)	220	220	220	220	220	220
DAILY OPERATING COSTS ($)	1430	1430	1430	1430	1430	1430
DAILY OVERHEAD ($)	248	248	248	248	248	248
DAILY PROFIT ($)	165	165	165	165	165	165
DAILY TUG COST ($)	2063	2063	2063	2063	2063	2063
LUBE OIL CONSUMPTION(BBL/DAY)						
LIGHT-RIVERS	7.7	7.7	7.7	7.7	7.7	7.7
LIGHT-BAYS AND SOUNDS	7.7	7.7	7.7	7.7	7.7	7.7
LOADED	9.2	9.2	9.2	9.2	9.2	9.2
MAIN ENG FUEL CONS(BBL/DAY)						
LIGHT-RIVERS	1469	1469	1469	1469	1469	1469
LIGHT-BAYS AND SOUNDS	1469	1469	1469	1469	1469	1469
LOADED	1763	1763	1763	1763	1763	1763
GENERATOR FUEL CONS(BBL/DAY)						
TUG-MAIN GENERATOR	150	150	150	150	150	150
BARGE-MAIN GENERATOR	251	270	347	362	412	212
ANNUAL OPERATING DAYS	350	350	350	350	350	350
BARGE						
DEADWEIGHT (TONS)	5500	5500	5500	5500	5500	5500
CARGO CAPACITY						
FULLY LOADED (TONS)	4138	4138	4138	4138	4138	4138
CAPITAL COST						
PRINCIPAL AMOUNT ($)	2000000	2000000	2000000	2000000	2000000	2000000
INTEREST RATE (%)	.12	.12	.12	.12	.12	.12
NUMBER OF PERIODS (YEARS)	20	20	20	20	20	20
DAILY CAPITAL COST ($)	734	734	734	734	734	734
DAILY OPERATING COST ($)	330	330	330	330	330	330
DAILY OVERHEAD ($)	106	106	106	106	106	106
DAILY PROFIT ($)	53	53	53	53	53	53
DAILY BARGE COST ($)	1223	1223	1223	1223	1223	1223

Exhibit 40 (continued)

TANK BARGE- DIRTY PRODUCTS
TUG-BARGE WATERWAYS COSTING MODEL

TRADE ROUTE						
LOADING PORT	NEW YORK	NEW YORK	NEW HAVEN	NEW HAVEN	NEW HAVEN	BOSTON
DISCHARGING PORT	HOLYOKE	SPRINGFIELD	HOLYOKE	SPRINGFIELD	WINDSOR LK.	SPRINGFIELD
ONE WAY DISTANCE (MILES)						
RIVERS	84	77	84	77	64	77
BAYS AND SOUNDS	79	79	22	22	22	140
PILOTAGE COST ($)	200	200	200	200	200	200
LOAD PORT COSTS ($)	0	0	0	0	0	0
DISCHARGE PORT COSTS ($)	0	0	0	0	0	0
TRUCKING COST ($)	100	0	100	0	9385	0
OTHER ASSUMPTIONS						
DIESEL FUEL OIL COST/GAL ($)	.85	.85	.85	.85	.85	.85
LUBE OIL COST/GAL ($)	3.50	3.50	3.50	3.50	3.50	3.50

OUTPUTS

VOYAGE PERFORMANCE						
CARGO PER VOYAGE (TONS)	4138	4138	4138	4138	4138	4138
TIME UNDERWAY(DAYS)						
RIVERS	1.02	.94	1.02	.94	.78	.94
BAYS AND SOUNDS	.96	.96	.27	.27	.27	1.70
LOAD PORT TIME (DAYS)	.33	.33	.33	.33	.33	.33
DISCHARGE PORT TIME (DAYS)	.33	.33	.33	.33	.33	.33
LOCK DELAYS (DAYS)	.17	.17	.17	.17	.08	.17
TOTAL VOYAGE TIME (DAYS)	2.81	2.73	2.12	2.03	1.79	3.47
VOYAGE COST ($)						
CAPITAL COSTS PER VOYAGE						
TUG	619	600	466	447	393	763
BARGE	2062	2000	1554	1491	1310	2543
OPERATING COSTS PER VOYAGE						
TUG	4020	3898	3029	2907	2553	4958
BARGE	928	900	699	671	589	1144
OVERHEAD COST PER VOYAGE	381	370	287	276	242	470
PROFIT PER VOYAGE	381	370	287	276	242	470
MAIN ENGINE FUEL COST/VOY.	2756	2638	1792	1674	1454	3669
LUBE OIL COST/VOY.	59	57	39	36	31	79
GENERATOR FUEL COST/VOY	983	972	895	884	852	1067
PILOTAGE COST PER VOYAGE	400	400	400	400	400	400
PORT CHARGES PER VOYAGE	0	0	0	0	0	0
TRUCKING COST PER VOYAGE	100	0	100	0	9385	0
TOTAL VOYAGE COSTS	12689	12204	9549	9063	17452	15565
REQUIRED FREIGHT RATE ($)						
FIXED(CAP., O.HEAD, PROFIT)	.83	.81	.63	.60	.53	1.03
VARIABLE						
OPERATING	1.20	1.16	.90	.86	.76	1.47
VOYAGE	1.04	.98	.78	.72	2.93	1.26
SUBTOTAL VARIABLE	2.23	2.14	1.68	1.59	3.69	2.74
TOTAL REQUIRED FREIGHT RATE($)	3.07	2.95	2.31	2.19	4.22	3.76

Exhibit 41

TANK BARGE- DOUBLE SKIN
TUG BARGE WATERWAYS COSTING MODEL

INPUTS	INBOUND	
	NEW YORK HOLYOKE	NEW HAVEN HOLYOKE
TUG		
VESSEL SIZE(HORSEPOWER)	1700	1700
VESSEL SPEED(KNOTS)		
LIGHT-RIVER	8.0	8.0
LIGHT-BAYS AND SOUNDS	8.0	8.0
LOADED-RIVERS	6.0	6.0
LOADED-BAYS AND SOUNDS	6.0	6.0
CAPITAL COST		
PRINCIPAL AMOUNT ($)	600000	600000
INTEREST RATE	.12	.12
NUMBER OF PERIODS (YEARS)	20	20
DAILY CAPITAL COST ($)	220	220
DAILY OPERATING COSTS ($)	1430	1430
DAILY OVERHEAD ($)	248	248
DAILY PROFIT ($)	165	165
DAILY TUG COST ($)	2063	2063
LUBE OIL CONSUMPTION(GAL/DAY)		
LIGHT-RIVERS	7.7	7.7
LIGHT-BAYS AND SOUNDS	7.7	7.7
LOADED	9.2	9.2
MAIN ENG FUEL CONS(BAL/DAY)		
LIGHT-RIVERS	1469	1469
LIGHT-BAYS AND SOUNDS	1469	1469
LOADED	1763	1763
GENERATOR FUEL CONS(GAL/DAY)		
TUG-MAIN GENERATOR	150	150
BARGE-MAIN GENERATOR	251	347
ANNUAL OPERATING DAYS	350	350
BARGE		
DEADWEIGHT (TONS)	9500	9500
CARGO CAPACITY		
FULLY LOADED (TONS)	4138	4138
CAPITAL COST		
PRINCIPAL AMOUNT ($)	3000000	3000000
INTEREST RATE	.12	.12
NUMBER OF PERIODS (YEARS)	20	20
DAILY CAPITAL COST ($)	1100	1100
DAILY OPERATING COST ($)	330	330
DAILY OVERHEAD ($)	143	143
DAILY PROFIT ($)	72	72
DAILY BARGE COST ($)	1645	1645

Exhibit 41 (continued)

TANK BARGE- DOUBLE SKIN
TUG BARGE WATERWAYS COSTING MODEL

TRADE ROUTE		
LOADING PORT	NEW YORK	NEW HAVEN
DISCHARGING PORT	HOLYOKE	HOLYOKE
ONE WAY DISTANCE (MILES)		
RIVERS	84	84
BAYS AND SOUNDS	79	22
PILOTAGE COST ($)	200	200
LOAD PORT COSTS ($)	0	0
DISCHARGE PORT COSTS ($)	0	0
TRUCKING COST ($)	0	0
OTHER ASSUMPTIONS		
DIESEL FUEL OIL COST/GAL ($)	.85	.85
LUBE OIL COST/GAL	3.50	3.50

OUTPUTS

VOYAGE PERFORMANCE		
CARGO PER VOYAGE (TONS)	4138	4138
TIME UNDERWAY(DAYS)		
RIVERS	1.02	1.02
BAYS AND SOUNDS	.96	.27
LOAD PORT TIME (DAYS)	.33	.33
DISCHARGE PORT TIME (DAYS)	.33	.33
LOCK DELAYS (DAYS)	.17	.17
TOTAL VOYAGE TIME (DAYS)	2.81	2.12
VOYAGE COST ($)		
CAPITAL COSTS PER VOYAGE		
TUG	619	466
BARGE	3093	2331
OPERATING COSTS PER VOYAGE		
TUG	4020	3029
BARGE	928	699
OVERHEAD COST PER VOYAGE	433	326
PROFIT PER VOYAGE	433	326
MAIN ENGINE FUEL COST/VOY.	2756	1792
LUBE OIL COST/VOY.	99	39
GENERATOR FUEL COST/VOY	963	895
PILOTAGE COST PER VOYAGE	400	400
PORT CHARGES PER VOYAGE	0	0
TRUCKING COST PER VOYAGE	0	0
TOTAL VOYAGE COSTS	13724	10303
REQUIRED FREIGHT RATE ($)		
FIXED(CAP.,O.HEAD,PROFIT)	1.11	.83
VARIABLE		
OPERATING	1.20	.90
VOYAGE	1.01	.76
SUBTOTAL VARIABLE	2.21	1.66
TOTAL REQUIRED FREIGHT RATE($)	3.32	2.49

Exhibit 42

COVERED HOPPER BARGE
TUG BARGE WATERWAYS COSTING MODEL

	INBOUND								OUTBOUND	
INPUTS	NEW YORK HOLYOKE	BOSTON SPRINGFIELD	BOSTON HOLYOKE	NEW YORK S. WINDSOR	CEMENTON WILBRAHAM	CEMENTON WINDSOR	CEMENTON CHICOPEE	BOSTON HARTFORD	HOLYOKE NEW YORK	HOLYOKE BOSTON
TUG										
VESSEL SIZE(HORSEPOWER)	2250	2250	2250	2250	2250	2250	2250	2250	2250	2250
VESSEL SPEED(KNOTS)										
LIGHT-RIVER	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
LIGHT-BAYS AND SOUNDS	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
LOADED-RIVERS	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
LOADED-BAYS AND SOUNDS	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
CAPITAL COST										
PRINCIPAL AMOUNT ($)	600000	600000	600000	600000	600000	600000	600000	600000	600000	600000
INTEREST RATE	.12	.12	.12	.12	.12	.12	.12	.12	.12	.12
NUMBER OF PERIODS (YEARS)	20	20	20	20	20	20	20	20	20	20
DAILY CAPITAL COST ($)	220	220	220	220	220	220	220	220	220	220
DAILY OPERATING COSTS ($)	1430	1430	1430	1430	1430	1430	1430	1430	1430	1430
DAILY OVERHEAD ($)	248	248	248	248	248	248	248	248	248	248
DAILY PROFIT ($)	165	165	165	165	165	165	165	165	165	165
DAILY TUG COST ($)	2063	2063	2063	2063	2063	2063	2063	2063	2063	2063
LUBE OIL CONSUMPTION(BBL/DAY)										
LIGHT-RIVERS	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7
LIGHT-BAYS AND SOUNDS	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7
LOADED	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2
MAIN ENG FUEL CONS(BBL/DAY)										
LIGHT-RIVERS	1469	1469	1469	1469	1469	1469	1469	1469	1469	1469
LIGHT-BAYS AND SOUNDS	1469	1469	1469	1469	1469	1469	1469	1469	1469	1469
LOADED	1763	1763	1763	1763	1763	1763	1763	1763	1763	1763
GENERATOR FUEL CONS(BBL/DAY)										
TUG-MAIN GENERATOR	150	150	150	150	150	150	150	150	150	150
BARGE-MAIN GENERATOR	473	374	365	342	331	354	385	404	473	365
ANNUAL OPERATING DAYS	350	350	350	350	350	350	350	350	350	350
BARGE										
DEADWEIGHT (TONS)	3500	3500	3500	3500	3500	3500	3500	3500	3500	3500
CARGO CAPACITY										
FULLY LOADED (TONS)	3500	3500	3500	3500	3500	3500	3500	3500	3500	3500
CAPITAL COST										
PRINCIPAL AMOUNT ($)	350000	350000	350000	350000	350000	350000	350000	350000	350000	350000
INTEREST RATE	.12	.12	.12	.12	.12	.12	.12	.12	.12	.12
NUMBER OF PERIODS (YEARS)	20	20	20	20	20	20	20	20	20	20
DAILY CAPITAL COST ($)	202	202	202	202	202	202	202	202	202	202
DAILY OPERATING COST ($)	230	230	230	230	230	230	230	230	230	230
DAILY OVERHEAD ($)	43	43	43	43	43	43	43	43	43	43
DAILY PROFIT ($)	22	22	22	22	22	22	22	22	22	22
DAILY BARGE COST ($)	496	496	496	496	496	496	496	496	496	496

Exhibit 42 (continued)

COVERED HOPPER BARGE
TUG BARGE WATERWAYS COSTING MODEL

TRADE ROUTE										
LOADING PORT	NEW YORK	BOSTON	BOSTON	NEW YORK	CEMENTON	CEMENTON	CEMENTON	BOSTON	HOLYOKE	HOLYOKE
DISCHARGING PORT	HOLYOKE	SPRINGFIELD	HOLYOKE	S. WINDSOR	SPRINGFIELD	S. WINDSOR	CHICOPEE	S. WINDSOR	NEW YORK	BOSTON
ONE WAY DISTANCE (MILES)										
RIVERS	84	77	84	58	77	58	81	58	84	84
BAYS AND SOUNDS	79	140	140	79	174	174	174	140	79	140
PILOTAGE COST ($)	200	200	200	200	200	200	200	200	200	200
LOAD PORT COSTS ($)	8250	8250	8250	8250	8250	8250	8250	8250	8250	8250
DISCHARGE PORT COSTS ($)	11000	11000	11000	11000	8250	8250	8250	16500	11000	11000
TRUCKING COST ($)	0	0	0	0	6600	7700	0	5500	0	0
RAILROAD COST ($)	0	0	0	0	0	0	0	0	0	0
OTHER ASSUMPTIONS										
DIESEL FUEL OIL COST/BAL ($)	.85	.85	.85	.85	.85	.85	.85	.85	.85	.85
LUBE OIL COST/BAL ($)	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50
OUTPUTS										
VOYAGE PERFORMANCE										
CARGO PER VOYAGE (TONS)	5500	5500	5500	5500	5500	5500	5500	5500	5500	5500
TIME UNDERWAY (DAYS)										
RIVERS	1.02	.94	1.02	.70	.94	.70	.98	.70	1.02	1.02
BAYS	.96	1.70	1.70	.96	2.11	2.11	2.11	1.70	.96	1.70
LOAD PORT TIME (DAYS)	.17	.17	.17	.17	.17	.17	.17	.17	.17	.17
DISCHARGE PORT TIME (DAYS)	.17	.17	.17	.17	.17	.17	.17	.17	.17	.17
LOCK DELAYS (DAYS)	.17	.17	.17	.08	.17	.08	.17	.08	.17	.17
TOTAL VOYAGE TIME(DAYS)	2.48	3.14	3.23	2.08	3.55	3.23	3.60	2.82	2.48	3.23
VOYAGE COST ($)										
CAPITAL COSTS PER VOYAGE										
TUG	547	691	710	458	782	712	793	621	547	710
BARGE	501	634	651	419	717	652	727	569	501	651
OPERATING COSTS PER VOYAGE										
TUG	3553	4492	4613	2973	5083	4624	5152	4033	3553	4613
BARGE	572	722	742	478	817	744	829	649	572	742
OVERHEAD COST PER VOYAGE	259	327	336	216	370	337	375	294	259	336
PROFIT PER VOYAGE	259	327	336	216	370	337	375	294	259	336
MAIN ENGINE FUEL COST/VOY.	2756	3669	3788	2317	4244	3923	4312	3348	2756	3788
LUBE OIL COST/VOY.	59	79	82	50	91	84	93	72	59	82
GENERATOR FUEL COST/VOY	1316	1400	1411	1223	1453	1385	1459	1328	1316	1411
FUEL & OIL COST/VOY	4132	5149	5280	3590	5789	5392	5864	4749	4132	5280
PILOTAGE COST PER VOYAGE	400	400	400	400	400	400	400	400	400	400
PORT CHARGES PER VOYAGE	19250	19250	19250	19250	16500	16500	16500	24750	19250	19250
TRUCKING COST	0	0	0	0	6600	7700	0	5500	0	0
RAILROAD COST	0	0	0	0	0	0	0	0	0	0
TOTAL VOYAGE COSTS	29472	31992	32318	28000	37428	37397	31015	41857	29472	32318
REQUIRED FREIGHT RATE ($)										
FIXED(CAP.,O.HEAD,PROFIT)	.28	.36	.37	.24	.41	.37	.41	.32	.28	.37
VARIABLE										
OPERATING	.75	.95	.97	.63	1.07	.98	1.09	.85	.75	.97
VOYAGE	4.32	4.51	4.53	4.23	5.33	5.45	4.14	6.44	4.32	4.53
SUBTOTAL VARIABLE	5.07	5.46	5.51	4.85	6.40	6.43	5.23	7.29	5.07	5.51
TOTAL REQUIRED FREIGHT RATE($)	5.36	5.82	5.88	5.09	6.81	6.80	5.64	7.61	5.36	5.88

Exhibit 43

OPEN HOPPER BARGE
TUG BARGE WATERWAYS COSTING MODEL

INPUTS	INBOUND								
	NEW YORK E LONGMEA	NEW YORK SPRINGFIELD	NEW YORK E WINDSOR	NEW YORK HOLYOKE	NEW YORK MT. TOM	PENNSYLVANIA MT. TOM	PENNSYLVANIA LONGMEADOW	W.VIRGINIA MT. TOM	KENTUCKY MT. TOM
TUG									
VESSEL SIZE(HORSEPOWER)	2250	2250	2250	2250	2250	2250	2250	2250	2250
VESSEL SPEED(KNOTS)									
LIGHT-RIVER	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
LIGHT-BAYS AND SOUNDS	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
LOADED-RIVERS	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
LOADED-BAYS AND SOUNDS	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
CAPITAL COST									
PRINCIPAL AMOUNT ($)	600000	600000	600000	600000	600000	600000	600000	600000	600000
INTEREST RATE	.12	.12	.12	.12	.12	.12	.12	.12	.12
NUMBER OF PERIODS (YEARS)	20	20	20	20	20	20	20	20	20
DAILY CAPITAL COST ($)	220	220	220	220	220	220	220	220	220
DAILY OPERATING COSTS ($)	1430	1430	1430	1430	1430	1430	1430	1430	1430
DAILY OVERHEAD ($)	248	248	248	248	248	248	248	248	248
DAILY PROFIT ($)	165	165	165	165	165	165	165	165	165
DAILY TUG COST ($)	2063	2063	2063	2063	2063	2063	2063	2063	2063
LUBE OIL CONSUMPTION(BBL/DAY)									
LIGHT-RIVERS	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7
LIGHT-BAYS AND SOUNDS	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7
LOADED	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2
MAIN ENG FUEL CONS(BBL/DAY)									
LIGHT-RIVERS	1469	1469	1469	1469	1469	1469	1469	1469	1469
LIGHT-BAYS AND SOUNDS	1469	1469	1469	1469	1469	1469	1469	1469	1469
LOADED	1763	1763	1763	1763	1763	1763	1763	1763	1763
GENERATOR FUEL CONS(GAL/DAY)									
TUG-MAIN GENERATOR	150	150	150	150	150	150	150	150	150
BARGE-MAIN GENERATOR	490	490	525	473	473	473	490	473	542
ANNUAL OPERATING DAYS	350	350	350	350	350	350	350	350	350
BARGE									
DEADWEIGHT (TONS)	3500	3500	3500	3500	3500	3500	3500	3500	3500
CARGO CAPACITY									
FULLY LOADED (TONS)	3500	3500	3500	3500	3500	3500	3500	3500	3500
CAPITAL COST									
PRINCIPAL AMOUNT ($)	500000	500000	500000	500000	500000	500000	500000	500000	500000
INTEREST RATE	.12	.12	.12	.12	.12	.12	.12	.12	.12
NUMBER OF PERIODS (YEARS)	20	20	20	20	20	20	20	20	20
DAILY CAPITAL COST ($)	183	183	183	183	183	183	183	183	183
DAILY OPERATING COST ($)	230	230	230	230	230	230	230	230	230
DAILY OVERHEAD ($)	41	41	41	41	41	41	41	41	41
DAILY PROFIT ($)	21	21	21	21	21	21	21	21	21
DAILY BARGE COST ($)	475	475	475	475	475	475	475	475	475

Exhibit 43 (continued)

OPEN HOPPER BARGE
TUG BARGE WATERWAYS COSTING MODEL

TRADE ROUTE									
LOADING PORT	NEW YORK	NEW YORK	NEW YORK	NEW YORK	NEW YORK	NEW YORK	NEW YORK	NEW YORK	NEW YORK
DISCHARGING PORT	E LONGMEA	SPRINGFIELD	E WINDSOR	HOLYOKE	HOLYOKE	HOLYOKE	SPRINGFIELD	HOLYOKE	S.WINDSOR
ONE WAY DISTANCE (MILES)									
RIVERS	77	77	64	84	84	84	77	84	58
BAYS AND SOUNDS	79	79	79	79	79	79	79	79	79
PILOTAGE COST ($)	200	200	200	200	200	200	200	200	200
LOAD PORT COSTS ($)	8250	8250	8250	8250	8250	8250	8250	8250	8250
DISCHARGE PORT COSTS ($)	11000	11000	11000	11000	11000	11000	11000	11000	11000
TRUCKING COST ($)	0	0	0	0	2750	2750	4950	2750	5500
RAILROAD COST ($)	0	0	0	0	79035	70785	70785	70785	70785
OTHER ASSUMPTIONS									
DIESEL FUEL OIL COST/GAL ($)	.85	.85	.85	.85	.85	.85	.85	.85	.85
LUBE OIL COST/GAL ($)	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50
OUTPUTS									
VOYAGE PERFORMANCE									
CARGO PER VOYAGE (TONS)	5500	5500	5500	5500	5500	5500	5500	5500	5500
TIME UNDERWAY (DAYS)									
RIVERS	.94	.94	.78	1.02	1.02	1.02	.94	1.02	.70
BAYS	.96	.96	.96	.96	.96	.96	.96	.96	.96
LOAD PORT TIME (DAYS)	.17	.17	.17	.17	.17	.17	.17	.17	.17
DISCHARGE PORT TIME (DAYS)	.17	.17	.17	.17	.17	.17	.17	.17	.17
LOCK DELAYS (DAYS)	.17	.17	.08	.17	.17	.17	.17	.17	.08
TOTAL VOYAGE TIME (DAYS)	2.40	2.40	2.15	2.48	2.48	2.48	2.40	2.48	2.08
VOYAGE COST ($)									
CAPITAL COSTS PER VOYAGE									
TUG	528	528	474	547	547	547	528	547	458
BARGE	440	440	395	456	456	456	440	456	381
OPERATING COSTS PER VOYAGE									
TUG	3432	3432	3077	3553	3553	3553	3432	3553	2973
BARGE	552	552	495	572	572	572	552	572	478
OVERHEAD COST PER VOYAGE	248	248	222	256	256	256	248	256	214
PROFIT PER VOYAGE	248	248	222	256	256	256	248	256	214
MAIN ENGINE FUEL COST/VOY.	2638	2638	2418	2756	2756	2756	2638	2756	2317
LUBE OIL COST/VOY.	57	57	52	59	59	59	57	59	50
GENERATOR FUEL COST/VOY	1306	1306	1234	1316	1316	1316	1306	1316	1223
FUEL & OIL COST/VOY	4000	4000	3704	4132	4132	4132	4000	4132	3590
PILOTAGE COST PER VOYAGE	400	400	400	400	400	400	400	400	400
PORT CHARGES PER VOYAGE	19250	19250	19250	19250	19250	19250	19250	19250	19250
TRUCKING COST	0	0	0	0	2750	2750	4950	2750	5500
RAILROAD COST	0	0	0	0	79035	70785	70785	70785	70785
TOTAL VOYAGE COSTS	29097	29097	28238	29422	111207	102957	104832	102957	104244
REQUIRED FREIGHT RATE ($)									
FIXED(CAP.,O.HEAD.PROFIT)	.27	.27	.24	.28	.28	.28	.27	.28	.23
VARIABLE									
OPERATING	.72	.72	.65	.75	.75	.75	.72	.75	.63
VOYAGE	4.30	4.30	4.25	4.32	19.19	17.69	18.07	17.69	18.10
SUBTOTAL VARIABLE	5.02	5.02	4.90	5.07	19.94	18.44	18.79	18.44	18.72
TOTAL REQUIRED FREIGHT RATE($)	5.29	5.29	5.13	5.35	20.22	18.72	19.06	18.72	18.95

Exhibit 44

OPEN HOPPER BARGE
TUG BARGE WATERWAYS COSTING MODEL

INPUTS	OUTBOUND ADAMS NEW YORK	SPRINGFIELD NEW YORK	SPRINGFIELD BOSTON
TUG			
VESSEL SIZE(HORSEPOWER)	2250	2250	2250
VESSEL SPEED(KNOTS)			
LIGHT-RIVER	8.0	8.0	8.0
LIGHT-BAYS AND SOUNDS	8.0	8.0	8.0
LOADED-RIVERS	6.0	6.0	6.0
LOADED-BAYS AND SOUNDS	6.0	6.0	6.0
CAPITAL COST			
PRINCIPAL AMOUNT ($)	600000	600000	600000
INTEREST RATE	.12	.12	.12
NUMBER OF PERIODS (YEARS)	20	20	20
DAILY CAPITAL COST ($)	220	220	220
DAILY OPERATING COSTS ($)	1430	1430	1430
DAILY OVERHEAD ($)	248	248	248
DAILY PROFIT ($)	165	165	165
DAILY TUG COST ($)	2063	2063	2063
LUBE OIL CONSUMPTION(BAL/DAY)			
LIGHT-RIVERS	7.7	7.7	7.7
LIGHT-BAYS AND SOUNDS	7.7	7.7	7.7
LOADED	9.2	9.2	9.2
MAIN ENG FUEL CONS(GAL/DAY)			
LIGHT-RIVERS	1469	1469	1469
LIGHT-BAYS AND SOUNDS	1469	1469	1469
LOADED	1763	1763	1763
GENERATOR FUEL CONS(GAL/DAY)			
TUG-MAIN GENERATOR	150	150	150
BARGE-MAIN GENERATOR	473	490	374
ANNUAL OPERATING DAYS	350	350	350
BARGE			
DEADWEIGHT (TONS)	5500	5500	5500
CARGO CAPACITY			
FULLY LOADED (TONS)	5500	5500	5500
CAPITAL COST			
PRINCIPAL AMOUNT ($)	500000	500000	500000
INTEREST RATE	.12	.12	.12
NUMBER OF PERIODS (YEARS)	20	20	20
DAILY CAPITAL COST ($)	183	183	183
DAILY OPERATING COST ($)	230	230	230
DAILY OVERHEAD ($)	41	41	41
DAILY PROFIT ($)	21	21	21
DAILY BARGE COST ($)	475	475	475

Exhibit 44 (continued)

OPEN HOPPER BARGE
TUG BARGE WATERWAYS COSTING MODEL

TRADE ROUTE			
LOADING PORT	ADAMS	SPRINGFIELD	SPRINGFIELD
DISCHARGING PORT	NEW YORK	NEW YORK	BOSTON
ONE WAY DISTANCE (MILES)			
RIVERS	84	77	77
BAYS AND SOUNDS	79	79	140
PILOTAGE COST ($)	200	200	200
LOAD PORT COSTS ($)	8250	8250	8250
DISCHARGE PORT COSTS ($)	11000	11000	11000
TRUCKING COST ($)	100	0	0
RAILROAD COST ($)	0	0	0
OTHER ASSUMPTIONS			
DIESEL FUEL OIL COST/GAL ($)	.85	.85	.85
LUBE OIL COST/GAL ($)	3.50	3.50	3.50
OUTPUTS			
VOYAGE PERFORMANCE			
CARGO PER VOYAGE (TONS)	5500	5500	5500
TIME UNDERWAY (DAYS)			
RIVERS	1.02	.94	.94
BAYS	.96	.96	1.70
LOAD PORT TIME (DAYS)	.17	.17	.17
DISCHARGE PORT TIME (DAYS)	.17	.17	.17
LOCK DELAYS (DAYS)	.17	.17	.17
TOTAL VOYAGE TIME (DAYS)	2.48	2.40	3.14
VOYAGE COST ($)			
CAPITAL COSTS PER VOYAGE			
TUG	547	528	691
BARGE	456	440	576
OPERATING COSTS PER VOYAGE			
TUG	3553	3432	4492
BARGE	572	552	722
OVERHEAD COST PER VOYAGE	256	248	324
PROFIT PER VOYAGE	256	248	324
MAIN ENGINE FUEL COST/VOY.	2756	2638	3669
LUBE OIL COST/VOY.	99	97	79
GENERATOR FUEL COST/VOY	1316	1306	1400
FUEL & OIL COST/VOY	4132	4000	5149
PILOTAGE COST PER VOYAGE	400	400	400
PORT CHARGES PER VOYAGE	19250	19250	19250
TRUCKING COST	100	0	0
RAILROAD COST	0	0	0
TOTAL VOYAGE COSTS	29522	29097	31928
REQUIRED FREIGHT RATE ($)			
FIXED(CAP.,O.HEAD,PROFIT)	.28	.27	.35
VARIABLE			
OPERATING	.75	.72	.95
VOYAGE	4.34	4.30	4.51
SUBTOTAL VARIABLE	5.09	5.02	5.46
TOTAL REQUIRED FREIGHT RATE ($)	5.37	5.29	5.81

Exhibit 45

BECK BARGE
TUG BARGE WATERWAYS COSTING MODEL

INBOUND

INPUTS	NEW YORK CHICOPEE	BOSTON CHICOPEE	NEW YORK HOLYOKE	BOSTON HOLYOKE	NEW YORK NORTHAMPTO	BOSTON NORTHAMPTO	NEW YORK GREENFIELD	NEW YORK ENFIELD	NEW YORK WINDSOR LK.	NEW YORK MANCHESTER	NEW YORK HARTFORD
TUG											
VESSEL SIZE(HORSEPOWER)	2250	2250	2250	2250	2250	2250	2250	2250	2250	2250	2250
VESSEL SPEED(KNOTS)											
LIGHT-RIVER	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
LIGHT-BAYS AND SOUNDS	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
LOADED-RIVERS	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
LOADED-BAYS AND SOUNDS	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
CAPITAL COST											
PRINCIPAL AMOUNT ($)	600000	600000	600000	600000	600000	600000	600000	600000	600000	600000	600000
INTEREST RATE	.12	.12	.12	.12	.12	.12	.12	.12	.12	.12	.12
NUMBER OF PERIODS (YEARS)	20	20	20	20	20	20	20	20	20	20	20
DAILY CAPITAL COST ($)	220	220	220	220	220	220	220	220	220	220	220
DAILY OPERATING COSTS ($)	1430	1430	1430	1430	1430	1430	1430	1430	1430	1430	1430
DAILY OVERHEAD COST ($)	248	248	248	248	248	248	248	248	248	248	248
DAILY PROFIT ($)	165	165	165	165	165	165	165	165	165	165	165
DAILY TUG COST ($)	2063	2063	2063	2063	2063	2063	2063	2063	2063	2063	2063
LUBE OIL CONSUMPTION(BBL/DAY)											
LIGHT-RIVERS	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7
LIGHT-BAYS AND SOUNDS	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7
LOADED	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2
MAIN ENG FUEL CONS(BBL/DAY)											
LIGHT-RIVERS	1469	1469	1469	1469	1469	1469	1469	1469	1469	1469	1469
LIGHT-BAYS AND SOUNDS	1469	1469	1469	1469	1469	1469	1469	1469	1469	1469	1469
LOADED	1763	1763	1763	1763	1763	1763	1763	1763	1763	1763	1763
GENERATOR FUEL CONS(BBL/DAY)											
TUG-MAIN GENERATOR	150	150	150	150	150	150	150	150	150	150	150
BARGE-MAIN GENERATOR	0	0	0	0	0	0	0	0	0	0	0
ANNUAL OPERATING DAYS	350	350	350	350	350	350	350	350	350	350	350
BARGE											
CONTAINER CAPACITY (CONT.)	180	180	180	180	180	180	180	180	180	180	180
CARGO CAPACITY											
FULLY LOADED (CONT.)	180	180	180	180	180	180	180	180	180	180	180
CAPITAL COST											
PRINCIPAL AMOUNT ($)	500000	500000	500000	500000	500000	500000	500000	500000	500000	500000	500000
INTEREST RATE	.12	.12	.12	.12	.12	.12	.12	.12	.12	.12	.12
NUMBER OF PERIODS (YEARS)	20	20	20	20	20	20	20	20	20	20	20
DAILY CAPITAL COST ($)	183	183	183	183	183	183	183	183	183	183	183
DAILY OPERATING COST ($)	230	230	230	230	230	230	230	230	230	230	230
DAILY OVERHEAD COST ($)	41	41	41	41	41	41	41	41	41	41	41
DAILY PROFIT ($)	21	21	21	21	21	21	21	21	21	21	21
DAILY BARGE COST ($)	475	475	475	475	475	475	475	475	475	475	475

Exhibit 45 (continued)

DECK BARGE
TUG BARGE WATERWAYS COSTING MODEL

TRADE ROUTE											
LOADING PORT	NEW YORK	BOSTON	NEW YORK	BOSTON	NEW YORK	BOSTON	NEW YORK	NEW YORK	NEW YORK	NEW YORK	NEW YORK
DISCHARGING PORT	CHICOPEE	CHICOPEE	HOLYOKE	HOLYOKE	HOLYOKE	HOLYOKE	HOLYOKE	WINDSOR LK.	WINDSOR LK	S. WINDSOR	S.WINDSOR
ONE WAY DISTANCE (MILES)											
RIVERS	81	81	84	84	84	84	84	64	64	58	58
BAYS AND SOUNDS	79	140	79	140	79	140	79	79	79	79	79
PILOTAGE COST ($)	200	200	200	200	200	200	200	200	200	200	200
LOAD PORT COSTS ($)	36000	36000	36000	36000	36000	36000	36000	36000	36000	36000	36000
DISCHARGE PORT COSTS ($)	72000	72000	72000	72000	72000	72000	72000	72000	72000	72000	72000
TRUCKING COST ($)	4500	4500	4500	4500	5760	5760	6933	3150	4500	6300	4500
OTHER ASSUMPTIONS											
DIESEL FUEL OIL COST/GAL ($)	.85	.85	.85	.85	.85	.85	.85	.85	.85	.85	.85
LUBE OIL COST/GAL ($)	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50
OUTPUTS											
VOYAGE PERFORMANCE											
CARGO PER VOYAGE (CONT.)	180	180	180	180	180	180	180	180	180	180	180
TIME UNDERWAY (DAYS)											
RIVERS	.98	.98	1.02	1.02	1.02	1.02	1.02	.78	.78	.70	.70
BAYS	.96	1.70	.96	1.70	.96	1.70	.96	.96	.96	.96	.96
LOAD PORT TIME (DAYS)	.50	.50	.50	.50	.50	.50	.50	.50	.50	.50	.50
DISCHARGE PORT TIME (DAYS)	.50	.50	.50	.50	.50	.50	.50	.50	.50	.50	.50
LOCK DELAYS (DAYS)	.17	.17	.17	.17	.17	.17	.17	.08	.08	.08	.08
TOTAL VOYAGE TIME (DAYS)	3.11	3.86	3.15	3.89	3.15	3.89	3.15	2.82	2.82	2.74	2.74
VOYAGE COST ($)											
CAPITAL COSTS PER VOYAGE											
TUG	685	849	693	857	693	857	693	620	620	604	604
BARGE	571	707	578	714	578	714	578	517	517	503	503
OPERATING COSTS PER VOYAGE											
TUG	4454	5514	4506	5566	4506	5566	4506	4030	4030	3925	3925
BARGE	716	887	725	895	725	895	725	648	648	631	631
OVERHEAD COST PER VOYAGE	321	398	325	402	325	402	325	291	291	283	283
PROFIT PER VOYAGE	321	398	325	402	325	402	325	291	291	283	283
MAIN ENGINE FUEL COST/VOY.	2706	3737	2756	3788	2756	3788	2756	2418	2418	2317	2317
LUBE OIL COST/VOY.	58	80	59	82	59	82	59	52	52	50	50
GENERATOR FUEL COST/VOY	397	492	402	496	402	496	402	359	359	350	350
FUEL & OIL COST/VOY	3161	4309	3217	4366	3217	4366	3217	2829	2829	2717	2717
PILOTAGE COST PER VOYAGE	400	400	400	400	400	400	400	400	400	400	400
PORT CHARGES PER VOYAGE	108000	108000	108000	108000	108000	108000	108000	108000	108000	108000	108000
TRUCKING COST	4500	4500	4500	4500	5760	5760	6933	3150	4500	6300	4500
TOTAL VOYAGE COSTS	123130	125961	123269	126100	124529	127360	125702	120775	122125	123647	121847
REQUIRED FREIGHT RATE ($)											
FIXED (CAP., O.HEAD, PROFIT)	10.55	13.06	10.67	13.19	10.67	13.19	10.67	9.55	9.55	9.30	9.30
VARIABLE											
OPERATING	28.72	35.56	29.06	35.89	29.06	35.89	29.06	25.99	25.99	25.31	25.31
VOYAGE	644.78	651.16	645.10	651.48	652.10	658.48	658.61	635.44	642.94	652.31	642.31
SUBTOTAL VARIABLE	673.51	686.72	674.15	687.37	681.15	694.37	687.67	661.43	668.93	677.63	667.63
TOTAL REQUIRED FREIGHT RATE (PER CONTAINER) ($)	684.06	699.78	684.83	700.56	691.83	707.56	696.35	670.97	678.47	686.93	676.93

Exhibit 46

BECK BARGE
TUG BARGE WATERWAYS COSTING MODEL

INPUTS	OUTBOUND												
	E LONGMEA NEW YORK	E LONGMEA BOSTON	WINDSOR L. NEW YORK	WINDSOR L. BOSTON	HOLYOKE NEW YORK	HOLYOKE BOSTON	SPRINGFIELD BOSTON	ADAMS NEW YORK	CHICOPEE NEW YORK	FLORENCE M. NEW YORK	SPRINGF. NEW YORK	MANCHESTER NEW YORK	HARTFORD NEW YORK
TUG													
VESSEL SIZE(HORSEPOWER)	2250	2250	2250	2250	2250	2250	2250	2250	2250	2250	2250	2250	2250
VESSEL SPEED(KNOTS)													
LIGHT-RIVER	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
LIGHT-BAYS AND SOUNDS	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
LOADED-RIVERS	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
LOADED-BAYS AND SOUNDS	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
CAPITAL COST													
PRINCIPAL AMOUNT ($)	600000	600000	600000	600000	600000	600000	600000	600000	600000	600000	600000	600000	600000
INTEREST RATE	.12	.12	.12	.12	.12	.12	.12	.12	.12	.12	.12	.12	.12
NUMBER OF PERIODS (YEARS)	20	20	20	20	20	20	20	20	20	20	20	20	20
DAILY CAPITAL COST ($)	220	220	220	220	220	220	220	220	220	220	220	220	220
DAILY OPERATING COSTS ($)	1430	1430	1430	1430	1430	1430	1430	1430	1430	1430	1430	1430	1430
DAILY OVERHEAD COST ($)	248	248	248	248	248	248	248	248	248	248	248	248	248
DAILY PROFIT ($)	165	165	165	165	165	165	165	165	165	165	165	165	165
DAILY TUG COST ($)	2063	2063	2063	2063	2063	2063	2063	2063	2063	2063	2063	2063	2063
LUBE OIL CONSUMPTION(GAL/DAY)													
LIGHT-RIVERS	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7
LIGHT-BAYS AND SOUNDS	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7
LOADED	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2
MAIN ENG FUEL CONS(GAL/DAY)													
LIGHT-RIVERS	1469	1469	1469	1469	1469	1469	1469	1469	1469	1469	1469	1469	1469
LIGHT-BAYS AND SOUNDS	1469	1469	1469	1469	1469	1469	1469	1469	1469	1469	1469	1469	1469
LOADED	1763	1763	1763	1763	1763	1763	1763	1763	1763	1763	1763	1763	1763
GENERATOR FUEL CONS(GAL/DAY)													
TUG-MAIN GENERATOR	130	130	130	130	130	130	130	130	130	130	130	130	130
BARGE-MAIN GENERATOR	0	0	0	0	0	0	0	0	0	0	0	0	0
ANNUAL OPERATING DAYS	350	350	350	350	350	350	350	350	350	350	350	350	350
BARGE													
CONTAINER CAPACITY (CONT.)	180	180	180	180	180	180	180	180	180	180	180	180	180
CARGO CAPACITY													
FULLY LOADED (CONT.)	180	180	180	180	180	180	180	180	180	180	180	180	180
CAPITAL COST													
PRINCIPAL AMOUNT ($)	500000	500000	500000	500000	500000	500000	500000	500000	500000	500000	500000	500000	500000
INTEREST RATE	.12	.12	.12	.12	.12	.12	.12	.12	.12	.12	.12	.12	.12
NUMBER OF PERIODS (YEARS)	20	20	20	20	20	20	20	20	20	20	20	20	20
DAILY CAPITAL COST ($)	183	183	183	183	183	183	183	183	183	183	183	183	183
DAILY OPERATING COST ($)	230	230	230	230	230	230	230	230	230	230	230	230	230
DAILY OVERHEAD COST ($)	41	41	41	41	41	41	41	41	41	41	41	41	41
DAILY PROFIT ($)	21	21	21	21	21	21	21	21	21	21	21	21	21
DAILY BARGE COST ($)	475	475	475	475	475	475	475	475	475	475	475	475	475

Exhibit 46 (continued)

DECK BARGE
TUG BARGE WATERWAYS COSTING MODEL

TRADE ROUTE													
LOADING PORT	E LONDREA	E LONDREA	WINDSOR LK	WINDSOR LK	HOLYOKE	HOLYOKE	SPRINGFIELD	HOLYOKE	CHICOPEE	HOLYOKE	SPRINGFIELD	S. WINDSOR	S. WINDSOR
DISCHARGING PORT	NEW YORK	BOSTON	NEW YORK	BOSTON	NEW YORK	BOSTON	BOSTON	NEW YORK	NEW YORK	NEW YORK	NEW YORK	NEW YORK	NEW YORK
ONE WAY DISTANCE (MILES)													
RIVERS	77	77	64	64	84	84	77	84	81	84	77	58	58
BAYS AND SOUNDS	79	140	79	140	79	140	140	79	79	79	79	79	79
PILOTAGE COST ($)	200	200	200	200	200	200	200	200	200	200	200	200	200
LOAD PORT COSTS ($)	72000	72000	72000	72000	72000	72000	72000	72000	72000	72000	72000	72000	72000
DISCHARGE PORT COSTS ($)	36000	36000	36000	36000	36000	36000	36000	36000	36000	36000	36000	36000	36000
TRUCKING COST ($)	4500	4500	4500	4500	4500	4500	4500	24750	4500	4500	4500	6300	4500
OTHER ASSUMPTIONS													
DIESEL FUEL OIL COST/BAL ($)	.85	.85	.85	.85	.85	.85	.85	.85	.85	.85	.85	.85	.85
LUBE OIL COST/BAL ($)	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50
OUTPUTS													
VOYAGE PERFORMANCE													
CARGO PER VOYAGE (CONT.)	180	180	180	180	180	180	180	180	180	180	180	180	180
TIME UNDERWAY (DAYS)													
RIVERS	.94	.94	.78	.78	1.02	1.02	.94	1.02	.98	1.02	.94	.70	.70
BAYS	.96	1.70	.96	1.70	.96	1.70	1.70	.96	.96	.96	.96	.96	.96
LOAD PORT TIME (DAYS)	.50	.50	.50	.50	.50	.50	.50	.50	.50	.50	.50	.50	.50
DISCHARGE PORT TIME (DAYS)	.50	.50	.50	.50	.50	.50	.50	.50	.50	.50	.50	.50	.50
LOCK DELAYS (DAYS)	.17	.17	.08	.08	.17	.17	.17	.17	.17	.17	.17	.08	.08
TOTAL VOYAGE TIME (DAYS)	3.07	3.81	2.82	3.56	3.15	3.89	3.81	3.15	3.11	3.15	3.07	2.74	2.74
VOYAGE COST ($)													
CAPITAL COSTS PER VOYAGE													
TUG	675	838	680	783	693	857	838	693	685	693	675	604	604
BARGE	562	698	517	653	578	714	698	578	571	578	562	503	503
OPERATING COSTS PER VOYAGE													
TUG	4384	5444	4030	5090	4506	5566	5444	4506	4454	4506	4384	3925	3925
BARGE	705	876	648	819	725	895	876	725	716	725	705	631	631
OVERHEAD COST PER VOYAGE	316	393	291	367	325	402	393	325	321	325	316	283	283
PROFIT PER VOYAGE	316	393	291	367	325	402	393	325	321	325	316	283	283
MAIN ENGINE FUEL COST/VOY.	2638	3669	2418	3490	2756	3788	3669	2756	2706	2756	2638	2317	2317
LUBE OIL COST/VOY.	57	79	52	74	59	82	79	59	58	59	57	50	50
GENERATOR FUEL COST/VOY	391	485	359	454	402	496	485	402	397	402	391	350	350
FUEL & OIL COST/VOY	3086	4234	2829	3978	3217	4366	4234	3217	3161	3217	3086	2717	2717
PILOTAGE COST PER VOYAGE	400	400	400	400	400	400	400	400	400	400	400	400	400
PORT CHARGES PER VOYAGE	108000	108000	108000	108000	108000	108000	108000	108000	108000	108000	108000	108000	108000
TRUCKING COST	4500	4500	4500	4500	4500	4500	4500	24750	4500	4500	4500	6300	4500
TOTAL VOYAGE COSTS	122945	125775	122125	124956	123259	125100	125775	143519	123130	123259	122945	123647	121847
REQUIRED FREIGHT RATE ($)													
FIXED(CAP.,O.HEAD,PROFIT)	10.39	12.90	9.55	12.06	10.67	13.19	12.90	10.67	10.55	10.67	10.39	9.30	9.30
VARIABLE													
OPERATING	28.27	35.11	25.99	32.82	29.06	35.89	35.11	29.06	28.72	29.06	28.27	25.31	25.31
VOYAGE	644.36	650.74	642.94	649.32	645.10	651.48	650.74	757.60	644.78	645.10	644.36	632.31	642.31
SUBTOTAL VARIABLE	672.64	685.85	668.93	682.14	674.15	687.37	685.85	786.65	673.51	674.15	672.64	677.63	667.63
TOTAL REQUIRED FREIGHT RATE (PER CONTAINER) ($)	683.03	698.75	678.47	694.20	684.83	700.56	698.75	797.33	684.06	684.83	683.03	686.93	676.93

Exhibit 47

SUMMARY OF TUG-BARGE COSTING MODEL SIMULATIONS

Required Freight Rate and Cost per Ton-Mile

($/ton or $/container)

Origin / Destination	Miles	Tank-Clean		Tank-Dirty		Tank-Double Skin		Covered Hopper		Open Hopper		Deck
		RFR ($ per ton)	($ per ton-mile)	RFR ($ per ton)	($ per ton-mile)	RFR ($ per ton)	($ per ton-mile)	RFR ($ per ton)	($ per ton-mile)	RFR ($ per ton)	($ per ton-mile)	RFR ($ per container)
Inbound												
New York to												
Manchester	145	-	-	-	-	-	-	-	-	-	-	686.93
East Windsor	145	-	-	-	-	-	-	-	-	5.13	0.035	-
South Windsor	135	-	-	-	-	-	-	4.85	0.036	-	-	676.93
Windsor Locks	143	-	-	-	-	-	-	-	-	-	-	678.47
E. Longmeadow	161	-	-	-	-	-	-	-	-	5.29	0.033	-
Springfield	156	3.07	0.020	2.95	0.019	-	-	-	-	5.29	0.034	-
Chicopee	160	-	-	-	-	-	-	-	-	-	-	684.06
Holyoke	163	3.16	0.019	-	-	3.32	0.020	5.07	0.031	5.35	0.033	684.83
Northampton	173	-	-	-	-	-	-	-	-	-	-	691.83
Amherst	177	-	-	3.07	0.017	-	-	-	-	-	-	-
Greenfield	188	-	-	-	-	-	-	-	-	-	-	698.35
Enfield	143	-	-	-	-	-	-	-	-	-	-	670.97
Hartford	145	-	-	-	-	-	-	-	-	-	-	676.93
New Haven to												
Springfield	99	2.28	0.023	2.19	0.022	-	-	-	-	-	-	-
Holyoke	106	2.37	0.022	-	-	2.49	0.023	-	-	-	-	-
Amherst	120	5.61	0.047	2.31	0.019	-	-	-	-	-	-	-
East Hampton	113	3.44	0.030	-	-	-	-	-	-	-	-	-
Suffield	78	-	-	4.22	0.054	-	-	-	-	-	-	-
Boston to												
Hartford	212	-	-	-	-	-	-	7.29	0.034	-	-	-
Chicopee	221	-	-	-	-	-	-	-	-	-	-	699.78
Holyoke	224	-	-	-	-	-	-	5.51	0.025	-	-	700.56
Northampton	234	-	-	-	-	-	-	-	-	-	-	700.56
Springfield	217	-	-	3.76	0.017	-	-	5.46	0.025	-	-	-
Rocky Hill to												
East Hampton	49	2.49	0.051	-	-	-	-	-	-	-	-	-
Cementon to												
Windsor	290	-	-	-	-	-	-	6.43	0.036	-	-	-
Chicopee	295	-	-	-	-	-	-	5.23	0.021	-	-	-
Wilbraham	259	-	-	-	-	-	-	6.40	0.025	-	-	-
Pennsylvania to												
Mt Tom	470	-	-	-	-	-	-	-	-	18.72	0.040	-
Longmeadow	490	-	-	-	-	-	-	-	-	19.02	0.042	-
West Virginia to												
Mt. Tom	470	-	-	-	-	-	-	-	-	18.72	0.040	-
Kentucky to												
Mt. Tom	480	-	-	-	-	-	-	-	-	18.95	0.039	-
Outbound												
Manchester to												
New York City	145	-	-	-	-	-	-	-	-	-	-	686.93
Hartford to												
New York City												676.93
Windsor Locks to												
New York City	143	-	-	-	-	-	-	-	-	-	-	678.47
Boston	204	-	-	-	-	-	-	-	-	-	-	694.20
E. Longmeadow to												
New York City	161	-	-	-	-	-	-	-	-	-	-	683.03
Boston	222	-	-	-	-	-	-	-	-	-	-	698.75
Springfield to												
New York City	156	3.07	0.020	-	-	-	-	-	-	5.29	0.034	683.03
Boston	217	3.91	0.018	-	-	-	-	-	-	5.81	0.027	698.75
Chicopee to												
New York City	160	3.12	0.020	-	-	-	-	-	-	-	-	684.06
Elizabeth	170	3.26	0.019	-	-	-	-	-	-	-	-	-
Holyoke to												
New York City	163	-	-	-	-	-	-	5.36	0.033	-	-	684.03
Boston	224	-	-	-	-	-	-	5.88	0.026	-	-	700.56
Florence to												
New York City	169	-	-	-	-	-	-	-	-	-	-	684.83
Florence to												
New York City	169	-	-	-	-	-	-	-	-	-	-	684.83
Adams to												
New York City	200	-	-	-	-	-	-	-	-	5.37	0.027	797.33

were refined. The RFR's resulting from the final model runs were reviewed with the operators who confirmed that they were reasonable for the service to be provided.

D.2 ALTERNATIVE MODAL RATES

Rates for competing modes of transportation were obtained from public records and interviews with carrier personnel. The most important competing modes are pipeline and railroad. Pipeline tariffs are required to be publicly filed by the Federal Energy Regulatory Commission (FERC). Trucking rates are less important from the prospective of competing linehaul carriers, but are required to calculate distribution costs prior and subsequent to movements by barge. Local drayage costs were obtained through interviews with trucking company personnel and public records of regulatory proceedings.

D.2.1 Railroad Rates

Railroad rates were obtained from the latest (1983) waybill sample collected by the ICC and abstracted by ALK Associates. The national data were screened using the criteria for inclusion shown in Exhibit 48. Railroad rates are not shown to protect company confidentiality.

A sample of these rates was tested by calling railroad rate departments to determine if the data were representative of their movements. The rate quotations confirmed the accuracy of the sample data, particularly with the largest tonnage movements.

D.2.2 Pipeline Rates

Mobil Pipe Line Company provides pipeline service between Providence, RI, and Springfield. Hartford was formerly a destination but was eliminated by Mobil's FERC Tariff No. A-1016 effective January 1, 1984. The current rate for gasoline delivery from Providence to Springfield is $0.7725 per barrel or $5.964 per short ton. For the 85-mile pipeline, this equals $0.070 per ton-mile.

Jet Lines, Inc. provides pipeline service for distillates between New Haven and points in the study area: Bradley Airport in Windsor Locks, CT; Enfield, CT; Melrose, CT; Ludlow, MA; Springfield, MA; and Westover, MA. Distillates also may be

Exhibit 48

CRITERIA FOR DATA INCLUSION DURING
WAYBILL SAMPLE SCREENING

1. COMMODITIES		
STCC Number	STCC Name	Level of Aggregation (Digits)
10	Metallic Ores	3
11	Coal	2
14	Minerals	3
28	Chemicals	5
29	Petroleum Products	5
32	Clay, Glass, Stone	5
33	Primary Metal Products	3
40	Scrap	4

2. ORIGIN AND DESTINATION FREIGHT STATIONS		
Connecticut	Massachusetts	
Bloomfield	Amherst	Ludlow
East Hartford	Armory	Milton Falls
East Windsor	Belchertown	Montague
East Windsor Hill	Chicopee	Mt. Tom
Hartford	Chicopee Falls	Northampton
Manchester	Deerfield	Palmer
S. Manchester	E. Deerfield	S. Deerfield
Suffield	E. Longmeadow	Springfield
Thompsonville	E. Hampton	Taylor Street
Warehouse Point	Erving	Three Rivers
Windsor	Greenfield	W. Springfield
Buckland	Holyoke	Westfield
	Indian Orchard	Woronoco

3. DESTINATION AND ORIGIN BEA'S	
Number	Name
1	Bangor
2	Portland
4	Boston
5	Providence
6	Hartford/New Haven
7	Albany/Schenectady
12	New York City
14	Williamsport
16	Pittsburgh
18	Philadelphia
19	Baltimore
60-63	West Virginia

loaded into the pipeline in East Hartford for shipment to the same destinations. Exhibit 49 shows rates currently charged for this transportation. Rates for movements from New Haven are $2.961 to Bradley Airport and $3.191 to Springfield. On a dollar per ton-mile basis these are $0.047 and $0.048, respectively.

D.2.3 Trucking Rates

Trucking rates were obtained from interviews with trucking firms that serve the area. Exhibit 50 shows rates for scrap metal, freight-all-kinds, lumber limestone, packaging materials, chemicals, #2 distillate oil, #6 residual oil, and containers.

The costs for drayage, or local moves by truck, in the study region were obtained from a shipper using these services. The usual cost is $.50 per ton for the first mile moved and $.10 per mile thereafter. Exhibit 51 shows these costs for one to 30 miles in dollars per ton and dollars per ton-mile.

Exhibit 49

JET LINES, INC. PIPELINE RATES FOR DISTILLATES[1],[2]

(1985)

Origin	Destination	Miles	Dollars per short ton	Dollars per ton-mile
New Haven, CT	Bradley Airport, CT	63	2.961	0.047
	Enfield, CT	62	2.961	0.048
	Melrose, CT	57	2.961	0.052
	Ludlow, MA	74	3.191	0.043
	Springfield, MA	67	3.191	0.048
	Westover, MA	84	3.191	0.038
East Hartford, CT	Bradley Airport, CT	19	2.303	0.121
	Enfield, CT	18	2.303	0.128
	Melrose, CT	13	2.303	0.177
	Ludlow, MA	30	2.533	0.084
	Springfield, MA	23	2.533	0.110
	Westover, MA	40	2.533	0.063

[1]Source: F.E.R.C. (I.C.C.) No. 6--Supplement No. 5, effective July 15, 1983.
[2]Distillates @ 6.580 barrels per short ton.

Exhibit 50

FREIGHT RATES FOR CURRENT
TRUCK MOVEMENTS WITHIN STUDY AREA[1]

Origin	Destination	Road Miles	Commodity	Truck Capacity in Pounds	Dollars Per Hundredweight	Dollars per Container[2]	Dollars Per Short Ton	Dollars Per Ton-Mile
New Haven	Springfield	62	Residual, #6	50,000	-	-	6.85	0.110
			Gasoline	56,000	-	-	5.84	0.094
	Holyoke	71	Distillate, #2	50,000	-	-	7.38	0.104
			Chemicals	40,000	-	-	4.00	0.056
	Amherst	82	Residual, #6	50,000	-	-	8.85	0.102
Rocky Hill	East Hampton	45	Gasoline	60,000	-	-	3.73	0.083
New York City	Holoyke	141	Freight, all kinds	30,000	1.99	-	39.80	0.282
			Container	36,000	-	578.72	-	-
	Manchester		Container	36,000	-	425.00	-	-
Boston	Holyoke	89	Freight, all kinds	30,000	1.46	-	29.20	0.328
			Container	36,000	-	372.50	-	-
Holyoke	New York City	141	Container	36,000	-	578.72	-	-
	Boston	89	Container	36,000	-	372.50	-	-
Springfield	New York City	132	Scrap paper	40,000	$0.75	-	$15.00	0.114
			Scrap metal	28,000	1.96	-	39.20	0.297
			Freight, all kinds	30,000	1.96	-	39.20	0.297
	Boston	87	Lumber	40,000	0.50	-	10.00	0.115
			Scrap metal	40,000	0.50	-	10.00	0.115
			Freight, all kinds	30,000	1.43	-	28.60	0.329
	East Hampton	25	Distillate, #2	50,000	-	-	4.05	0.162
Adams	New York City	154	Limestone	44,000	1.02	-	20.45	0.133
	Boston	147	Limestone	44,000	.63	-	12.50	0.085
Manchester	New York City	118	Container	36,000	-	425.00	-	-
Chicopee	New York City	139	Packaging	40,000	2.00	-	40.00	0.288

[1]Source: Rates from questionnaire respondents and trucking companies operating in area.
[2]Round trip with loaded and empty container.

Exhibit 51

LOCAL DRAYAGE RATES FOR
DRY CARGO IN STUDY REGION[1]

Distance	Dollars per Ton	Dollars per Ton-Mile
1	$ .50	$0.500
2	.60	0.300
3	.70	0.233
4	.80	0.200
5	.90	0.180
6	1.00	0.166
7	1.10	0.157
8	1.20	0.150
9	1.30	0.144
10	1.40	0.140
11	1.50	0.136
12	1.60	0.133
13	1.70	0.131
14	1.80	0.129
15	1.90	0.127
16	2.00	0.125
17	2.10	0.124
18	2.20	0.122
19	2.30	0.121
20	2.40	0.119
21	2.50	0.118
22	2.60	0.118
23	2.70	0.117
24	2.80	0.117
25	2.90	0.116
26	3.00	0.115
27	3.10	0.115
28	3.20	0.114
29	3.30	0.114
30	3.40	0.113

[1]Source: Interview with local shipper.

E. POTENTIAL RIVER TRAFFIC

E.1 USER SURVEY

The user survey was made in two stages. The qualifying stage included a telephone interview to each of the 605 potential users that were identified as described above in Section C.2. and the completion of a Qualification Survey Form by the interviewer. A sample copy of the form is shown in Appendix D.

The results on the forms were carefully reviewed to identify those shippers and receivers who handled truckload size or greater quantities of liquid bulk, dry bulk, neo-bulk, or containerized commodities.

All respondents who had these kinds of shipments in 1984 were determined to be qualified for the Tonnage and Rate Survey.

Those respondents who indicated no interest in using river transportation but who were qualified shippers, were included in the follow-up survey and were sent questionnaires.

The questionnaire was designed to collect information about:

- Current shipments and receipts
- Future shipments and receipts
- Origins and destinations
- Lot sizes
- Modes used
- Frequency of shipments
- Container utilization
- Ocean ports used
- Time constraints
- Service characteristics
- Rates charged by land modes

- Ancillary costs of

  --Prior movements

  --Subsequent movements

  --Transfers between modes

  --Handling

  --Demurrase

- Estimated savings per ton necessary for shift to water mode.

A sample copy of the Tonnage and Rate Survey Form is shown in Appendix E, along with a copy of the cover letter.

A total of 256 Tonnage and Rate Surveys were mailed out to respondents. Follow-up telephone calls were made after 7 days if the questionnaires were not returned. A total of 23 written forms were received and 64 additional forms were completed through telephone interviews. Out of the 256 questionnaires mailed to respondents, 87 were completed.

E.2 POTENTIAL RIVER TRAFFIC

The results of the Tonnage and Rate Survey show that 1,005,837 tons of inbound bulk freight could have used barge service on the Connecticut River between Hartford and Holyoke in 1984. In addition, there were 3,670 inbound container movements and 4,288 outbound from the study area via ocean ports. Exhibit 52 shows that both liquid and dry bulk commodities were susceptible to diversion on the river.

Not all of the movements shown in Exhibit 52 would shift to the river. The comparison of barge costs and current land mode costs shows that containers, both inbound and outbound, can move significantly cheaper to ocean ports by truck. Some small lots of coal are more economic by truck and rail.

E.2.1. Liquid Bulk Movements

Pipeline is the major mode for #2 distillate oil movements from New Haven. Gasoline generally is delivered into the region by truck from New Haven. Small lots of heavy distillates and chemicals are brought in by truck, but railcars are used for

Exhibit 52

1984 SHIPMENTS THAT COULD HAVE USED BARGE SERVICE ON THE CONNECTICUT RIVER BETWEEN HARTFORD AND HOLYOKE[1]

Commodity	Barge Type	Origin	Destination	Via River Terminal	Barge Cost[2]	Current Modes	Current Rate ($/ton)	Lot Size (tons)	Total Tons
Inbound									
Fuel Oil #2	Tank-Clean	New Haven	Springfield	Springfield	2.28	P	3.19	1,533	28,000
			Springfield	Springfield	2.28	P	3.19	-	57,143
			Springfield	Springfield	2.28	P	3.19	1,266	29,000
			Springfield	Springfield	2.28	P	3.19	1,575	37,500
			Springfield	Springfield	2.28	R	*	100	*
			Holyoke	Holyoke	2.37	P	3.19	-	19,000
			Amherst	Holyoke	5.61	P&T	7.24	-	7,237
			Amherst	Holyoke	5.61	P	3.19		7,240
			East Hampton	Holyoke	3.44	P&T	7.24	-	4,000
Gasoline	Tank-Clean	New Haven	Springfield	Springfield	2.28	T	5.84	28	70,000
		Rocky Hill	East Hampton	Holyoke	2.49	T	3.73	29	1,500
Fuel Oil #4	Tank-Dirty	New Haven	Springfield	Springfield	2.19	T	6.85	23	1,136
Fuel Oil #6	Tank-Dirty	New Haven	Suffield	Windsor Locks	4.22	T	6.85	25	0
			Amherst	Holyoke	2.31	T	8.85	25	1,478
			Springfield	Springfield	2.19	R	*	100	*
		Boston	Springfield	Springfield	3.76	R	*	100	*
Chemicals, Liquid	Tank-Double Skin	New Haven	Holyoke	Holyoke	2.49	T	4.00	20	30,000
Rock Salt	Covered Hopper	Boston	Hartford	South Windsor	7.29	R	*	1,000	*
Cement	Covered Hopper	New York State	Windsor	South Windsor	6.43	R	*	100	*
			Chicopee	Chicopee	5.23	R	*	100	*
			Wilbraham	Springfield	6.40	R	*	100	*
Coal	Open Hopper	Pennsylvania	Mt. Tom	Holyoke	18.72	R	*	100	*
			Longmeadow	Springfield	19.02	T	18.65	25	2,330
		West Virginia	Mt. Tom	Holyoke	18.72	R	*	100	*
		Kentucky	Mt. Tom	Springfield	18.95	R	*	100	*
Container	Deck	New York City	Greenfield	Holyoke	716.22	T	698.35		(4)[3]
			Northampton	Holyoke	709.70	T	691.83		(268)
			Chicopee	Chicopee	701.62	T	684.06	-	(33)
			Enfield	Windsor Locks	686.69	T	670.97	-	(258)
			Windsor Locks	Windsor Locks	694.19	T	678.47	-	(1,388)
			Manchester	South Windsor	702.02	T	686.93		(16)
			Manchester	South Windsor	702.02	T	686.93		(33)
			Manchester	South Windsor	702.02	T	686.93		(20)
			Hartford	South Windsor	692.02	T	686.93		(1,650)
Total Bulk									1,005,837
Total Containers									(3,670)
Outbound									
Container	Deck	Chicopee	New York City	Chicopee	701.62	T	684.06		(33)
		Florence	New York City	Holyoke	702.70	T	684.83		(333)
		W. Springfield	New York City	Springfield	700.17	T	683.03		(400)
		Springfield	New York City	Springfield	700.17	T	683.03		(83)
			New York City	Springfield	700.17	T	683.03		(267)
			New York City	Springfield	700.17	T	683.03		(4)
		Windsor Locks	New York City	Springfield	716.30	T	678.47		(1,000)
		Manchester	New York City	South Windsor	702.02	T	686.93		(6)
		Hartford	New York City	South Windsor	692.02	T	676.93		(25)
		Adams	New York City	Holyoke	815.20	T	797.33		(2,137)
Total Containers									(4,288)

[1]Source: B&C/TBS Qualification Survey, Tonnage and Rate Data Questionnaire, ICC Waybill Sample, and interviews with shippers.
[2]Barge cost in dollars per ton for bulk shipments and dollars per container for containerized shipments. Barge cost includes prior and subsequent moves by other modes and transfer costs.
[3]Numbers in parentheses denote number of containers.

*Suppressed to maintain company confidentiality.

large volume movements to power plants. The lower viscosity oils such as #4 and #6 can not be shipped by pipeline. There are no liquid bulk movements outbound.

E.2.2. Dry Bulk Movements

Dry bulk commodities are principally rock salt, cement, and coal. The first two originate in New York State and are delivered by rail.

Coal generally arrives by rail, except for smaller shipments of anthracite that is trucked in for home and industrial heating. The major movements are for power plants that are generating electricity. There are no dry bulk movements outbound.

E.2.3 Neo-Bulk Movements

There are no neo-bulk movements inbound or outbound that could use barge services.

E.2.4 Container Movements

A total of 3,670 inbound container movements during 1984 were identified. These averaged 15 to 20 tons and represented a maximum weight inbound of 73,400 tons. The material carried varies widely from chemicals in drums to paper and other raw materials used by the manufacturing industries located in the study area. Some finished products are also imported for distribution within the northeast states.

A total of 4,288 outbound container movements in 1984 were identified. At a maximum average weight of 20 tons, these would total 85,760 tons outbound in 1984. These exports included lumber, paper products, machinery, and dry chemicals.

The principal ocean ports that were used for container shipments were New York City and Boston.

E.3 PROJECTED WATERWAY USE

The economic forecasting variables described in Section B. above were selectively applied to the identified commodity movements to determine expected future production and consumption in the region and the subsequent derived demand for transportation services.

E.3.1 Forecasting Methodology

The forecasts were based on a series of three processes. For the initial years, 1985 to 1990, the shippers and consignees were asked to identify the changes that they expected in their current traffic that was susceptible to river service. When that information was supplied, it was used to forecast the first six years' traffic level (1985 to 1990).

When no customer provided data was available, the following intermediate stage process was applied earlier. REMI regional forecasts were the basis for projecting the intermediate 1991 to 1995 traffic levels.

The long term projections from 1996 to 2040 were straight line extrapolations of the REMI forecasts from 1990 to 1995.

E.3.2 Forecasting Factors

The forecasting factors are shown in Exhibit 53. Since REMI forecasts are in terms of nominal dollars, it was necessary to reduce their values to 1984 dollars by applying a forecasted Consumer Price Index adjustment. The factors were then selected for their application to the commodity in question.

Imports to the study region counties have been forecasted by REMI for 49 industry sectors. The appropriate importing industries for river traffic developments are:

- Distillate oil #2--Petroleum products (SIC 29)
- Chemicals--Chemicals (SIC 28)
- Cement and Salt--Stone, clay, other non-metallic minerals (SIC 32)

Since the consumption of heavy distillate oils #4 and #6 is for electric generation, the Public Utilities (SIC 49) category for imports into the region would not be appropriate. This measures imports of electrical power, not imports of the production factors such as oil and coal that are needed to generate electricity. The appropriate index is Self Supply which measures how much of the inputs for the Public Utilities sector are obtained locally.

For consumption of gasoline, which is primarily used for automobiles, the direct measure of expected regional population was used.

Exhibit 53

FORECASTING FACTORS FOR BENEFIT ANALYSIS[1]

		1986	1985	1990	1995	2000	2010	2020	2030	2040
Hampden/Hampshire Counties										
Consumer Price Index		316.700	333.927	428.146	509.634	-	-	-	-	-
	--Ratio to 1986	1.000	1.054	1.352	1.609	1.886	2.380	2.994	3.408	3.922
Imports to Area:										
Petroleum products (29)	(billion nominal $)	.34317	.37129	.49993	.63251	-	-	-	-	-
(for #2 oil)	(billion 1986 $)	.34317	.35226	.36977	.39311	-	-	-	-	-
	--Ratio to 1986	1.000	1.026	1.078	1.146	1.991	2.483	3.375	4.266	5.158
Chemicals (28)	(billion nominal $)	.43715	.48638	.72535	.96672	-	-	-	-	-
	(billion 1986 $)	.43715	.45954	.53650	.58839	-	-	-	-	-
	--Ratio to 1986	1.000	1.051	1.227	1.346	1.663	1.702	1.940	2.177	2.414
Stone, clay, etc. (32)	(billion nominal $)	.08345	.08823	.07197	.09306	-	-	-	-	-
(for cement and salt)	(billion 1986 $)	.08345	.08376	.05294	.05784	-	-	-	-	-
	--Ratio to 1986	1.000	1.053	1.218	1.331	1.644	1.670	1.895	2.121	2.346
Self Supply:										
Public utilities (49)	(billion nominal $)	.39084	.37868	.52120	.67768	-	-	-	-	-
(for #4 and #6 oil	(billion 1986 $)	.39084	.35928	.38530	.42118	-	-	-	-	-
and coal)	--Ratio to 1986	1.000	1.026	1.101	1.203	1.309	1.509	1.713	1.917	2.121
Population	(thousands)	588.888	593.636	619.384	643.720	-	-	-	-	-
(for gasoline)	--Ratio to 1986	1.000	1.008	1.052	1.093	1.134	1.216	1.298	1.380	1.462
Hartford County										
Consumer Price Index		317.390	335.304	432.847	516.234	-	-	-	-	-
	--Ratio to 1986	1.000	1.056	1.364	1.626	1.888	2.412	2.936	3.460	3.984
Imports to Area:										
Petroleum products (29)	(billion nominal $)	.68917	.79036	1.08834	1.31686	-	-	-	-	-
(for #2 oil)	(billion 1986 $)	.68917	.71097	.79391	.88950	-	-	-	-	-
	--Ratio to 1986	1.000	1.037	1.100	1.181	1.262	1.424	1.586	1.748	1.910
Chemicals (28)	(billion nominal $)	.57266	.64729	1.01778	1.39059	-	-	-	-	-
	(billion 1986 $)	.57266	.61130	.74617	.86014	-	-	-	-	-
	--Ratio to 1986	1.000	1.067	1.303	1.502	1.701	2.099	2.497	2.895	3.293
Stone, clay, etc. (32)	(billion nominal $)	.09936	.11133	.16671	.21772	-	-	-	-	-
(for cement and salt)	(billion 1986 $)	.09936	.10543	.12222	.13390	-	-	-	-	-
	--Ratio to 1986	1.000	1.061	1.230	1.348	1.466	1.702	1.938	2.174	2.410
Self Supply:										
Public utilities (49)	(billion nominal $)	.66047	.73065	1.01370	1.32619	-	-	-	-	-
(for #4 and #6 oil	(billion 1986 $)	.66047	.69190	.74318	.81638	-	-	-	-	-
and coal)	--Ratio to 1986	1.000	1.035	1.112	1.218	1.324	1.536	1.748	1.960	2.172
Population	(thousands)	829.956	860.086	883.185	910.296	-	-	-	-	-
(for gasoline)	--Ratio to 1986	1.000	1.102	1.064	1.106	1.148	1.232	1.316	1.400	1.484

[1]Source: Regional Economic Models, Inc. Central Permanente FS-53 (1986 to 1995).
Straight line projections 1995 to 2040.

After the forecasting factors were adjusted to constant 1984 dollars, ratios were computed to measure change against the 1984 base year.

E.4 ESTIMATED SAVINGS

The transportation cost savings were calculated for 1990, and each subsequent tenth year. The savings were determined by forecasting future traffic and then multiplying the tons by the cost saving per ton in 1984 to determine savings in future years.

The calculation of economic benefits is shown in Exhibit 54. For each commodity the cost saving per ton by barge was determined by subtracting the barge cost from the land mode cost shown above in Exhibit 52. The cost saving per ton was multiplied by the number of tons shipped in 1984 to determine the 1984 benefit in dollars. The result was $3,146,390 for 1984.

The annual traffic for 1985 and 1990 and the decade years to 2040 was forecasted. The 1984 cost savings was then applied. The results shown on Exhibit 54 are the traffic in tons and the expected benefits in 1984 dollars for 1985 and the decade years.

The base year was established in 1990 as the first year after construction of the project. Benefits for 1990 and decades from 2000 to 2040 were calculated. The total navigation benefits are shown in Ehxibit 55. The present value of the incremental savings over the project life are shown for each decade. They total $54,861,096. Also shown are the annual benefits which total $#4,678,498.

E.5. RIVER RELATED DEVELOPMENT

Both Massachusetts and Connecticut have undertaken Connecticut River-related projects which will have regional economic impacts. The Connecticut State Department of Environmental Management, in cooperation with the National Park Service, has instituted the Connecticut River Action Program, designed to increase public access to the river's resources and to spur local community development. The Connecticut River also plays a prominent role in the Massachusetts Heritage Park program, with one park completed in Holyoke, adjacent to its historic canals, and a new park now underway upriver from Holyoke at Turner's Falls.

Exhibit 54

CALCULATION OF ECONOMIC BENEFITS OF THE PROJECT

Commodity	Cost Savings per Ton (dollars)	Base Year Traffic (1984 tons)	1984 Benefit (dollars)	1985 Traffic (tons)	1985 Benefit (dollars)	1990 Traffic (tons)	1990 Benefit (dollars)	2000 Traffic (tons)	2000 Benefit (dollars)	2010 Traffic (tons)	2010 Benefit (dollars)	2020 Traffic (tons)	2020 Benefit (dollars)	2030 Traffic (tons)	2030 Benefit (dollars)	2040 Traffic (tons)	2040 Benefit (dollars)
Fuel Oil #2	$0.91	193,028	$ 176,303	198,888	$ 180,978	208,947	$ 190,141	308,380	$ 280,626	401,275	$ 437,960	654,174	$ 595,294	826,878	$ 752,452	999,764	$ 909,786
	0.82	19,000	15,580	19,494	15,985	20,482	16,795	30,229	24,788	46,328	37,989	64,125	52,583	81,054	66,464	98,002	80,362
	1.63	7,237	11,796	7,425	12,103	7,801	12,716	11,514	18,768	17,969	29,289	24,425	39,813	30,873	50,323	37,328	60,845
	3.80	4,000	15,200	4,104	15,595	4,312	16,386	6,364	24,183	9,932	37,742	13,500	51,300	17,064	64,843	20,632	78,402
TOTAL		231,305	$ 218,959	229,891	$ 224,653	241,542	$ 236,038	356,487	$ 348,365	555,504	$ 542,980	756,224	$ 738,990	955,861	$ 934,082	1,155,726	$1,129,395
Gasoline	3.56	70,000	$ 249,200	70,560	$ 251,194	73,668	$ 262,158	79,380	$ 282,593	85,120	$ 303,027	90,860	$ 323,462	96,600	$ 343,896	102,340	$ 364,049
	1.24	1,500	1,860	1,512	1,875	1,578	1,957	1,701	2,109	1,824	2,262	1,947	2,414	2,070	2,567	2,193	2,719
TOTAL		71,500	$ 251,060	72,072	$ 253,069	75,218	$ 264,115	81,081	$ 284,702	86,944	$ 305,289	92,807	$ 325,876	98,670	$ 346,463	104,533	$ 367,049
Fuel Oil #4	4.66	1,136	$ 5,294	1,166	$ 5,434	1,251	$ 5,830	1,482	$ 6,906	1,714	$ 7,987	1,946	$ 9,068	2,178	$ 10,149	2,409	$ 11,226
TOTAL		1,136	$ 5,294	1,166	$ 5,434	1,251	$ 5,830	1,482	$ 6,906	1,714	$ 7,987	1,946	$ 9,068	2,178	$ 10,149	2,409	$ 11,226
Fuel Oil #6	2.78	80,022	$ 222,461	82,103	$ 228,246	88,104	$ 244,929	104,629	$ 290,313	120,753	$ 355,693	137,078	$ 381,077	153,602	$ 426,658	169,727	$ 471,841
	2.63	0	0	0	0	66,000	173,580	78,583	206,673	91,165	239,764	137,078	272,058	116,331	305,951	128,914	339,044
	6.54	1,478	9,666	1,516	9,915	1,627	10,641	1,929	12,616	2,230	14,584	2,532	16,559	2,833	18,528	3,135	20,503
	3.66	10,959	40,110	11,244	41,153	12,066	44,162	14,301	52,342	16,537	60,525	18,773	68,709	21,008	76,889	23,244	85,073
TOTAL		92,459	$ 272,237	94,863	$ 279,314	167,797	$ 473,312	199,242	$ 561,944	230,685	$ 650,566	262,131	$ 739,203	293,574	$ 827,026	325,020	$ 916,461
Chemicals	1.51	30,000	$ 45,300	31,530	$ 47,610	36,810	$ 55,583	43,950	$ 66,365	51,060	$ 77,101	58,200	$ 87,882	65,310	$ 98,618	72,420	$ 109,354
TOTAL		30,000	$ 45,300	31,530	$ 47,610	36,810	$ 55,583	43,950	$ 66,365	51,060	$ 77,101	58,200	$ 87,882	65,310	$ 98,618	72,420	$ 109,354
Rock Salt	4.86	65,000	$ 315,900	68,965	$ 335,178	79,950	$ 388,557	95,290	$ 493,109	110,630	$ 537,662	125,970	$ 612,214	141,310	$ 686,767	156,650	$ 761,319
TOTAL		65,000	$ 315,900	68,965	$ 335,178	79,950	$ 388,557	95,290	$ 493,109	110,630	$ 537,662	125,970	$ 612,214	141,310	$ 686,767	156,650	$ 761,319
Cement	5.65	12,500	$ 70,625	13,263	$ 74,936	15,375	$ 86,869	18,325	$ 103,536	21,275	$ 120,204	24,225	$ 136,871	27,175	$ 153,539	30,125	$ 170,206
	6.85	40,000	274,000	42,120	288,522	48,720	333,732	57,760	395,656	66,800	457,588	75,800	519,230	84,840	581,154	93,840	642,804
	5.68	45,000	255,600	47,385	269,147	54,810	311,321	64,980	369,086	75,150	426,852	85,275	484,362	95,445	542,128	105,570	599,630
TOTAL		47,500	$ 600,225	102,768	$ 632,605	118,905	$ 731,922	141,065	$ 868,278	163,225	$1,004,636	185,300	$1,140,463	207,460	$1,276,821	229,535	$1,412,640
Coal	2.99	330,037	$1,010,731	346,826	$1,037,810	372,179	$1,112,815	441,138	$1,319,003	510,098	$1,525,193	579,057	$1,731,380	648,017	$1,937,571	716,976	$2,143,758
	5.16	74,900	386,484	76,847	396,531	82,465	425,519	97,745	504,364	113,024	583,204	128,304	662,049	143,583	740,888	158,863	819,733
	10.05	4,000	40,200	4,140	41,607	4,448	44,702	5,296	53,225	6,144	61,747	6,992	70,270	7,840	78,792	8,688	87,314
TOTAL		416,932	$1,437,415	427,813	$1,475,148	459,092	$1,583,036	544,179	$1,876,592	629,266	$2,170,144	714,353	$2,463,699	779,440	$2,757,251	884,527	$3,050,805
GRAND TOTAL		1,005,837	$3,146,990	1,029,068	$3,253,003	1,180,565	$3,730,393	1,462,776	$4,506,261	1,829,028	$5,296,365	2,196,931	$6,117,395	2,563,803	$6,937,977	2,930,820	$7,758,257

Exhibit 55

NAVIGATION BENEFITS

Interest Rate: 8 3/8%
Project Life: 50 Years

	Base Year	Decades					
	1990	2000	2010	2020	2030	2040	Total
Shift of Mode Benefits:							
Projected Tonnage	1,180,565	1,462,776	1,829,028	2,196,931	2,563,803	2,930,820	
Benefit (Savings)	3,738,393	4,506,261	5,296,365	6,117,395	6,937,977	7,758,257	
Present Value of Incremental Savings (over project life)	43,837,219	6,391,036	2,848,721	1,227,324	451,964	105,032	54,861,096
Annual Benefits	3,738,393	545,021	242,936	104,665	38,526	8,957	4,678,498

E.5.1. Riverfront Recapture

The Riverfront Recapture Plan is a long-range plan for the west side of the Connecticut River between Windsor and Wethersfield and between the Bulkeley Bridge and the Hockanum River in East Hartford. The Plan calls for a linear park extending along the Connecticut River between the Bulkeley Bridge and the Hockanum River in East Hartford. The park development is tied to a reconstruction of the I-91/I-84 interchange and an effort to reduce barriers to downtown development north of I-84.

Spinoffs expected from the project include:

- o New office and industrial development in Hartford's North Meadows;
- o New housing and mixed-use residential/commercial development in the downtown and Colt Park area; and
- o Possibilities for long range development of a 200-acre industrial/office park.

Also included in the plan is a pedestrian bridge to span the Connecticut River and link the East Hartford and Hartford pedestrian walks.

E.5.2. Brainard Field and Brainard Industrial Park

Brainard Airport occupies a 201.58 acre site approximately two miles southeast of downtown Hartford. The site is bounded on the east by the Connecticut River dike and on the south by the Metropolitan District Commission's Water Pollution Control Plant. Land developments with mixed commercial and industrial uses lie to the west and the proposed resource recovery plant site is to the north.

Brainard Field is a reliever airport which diverts general aviation traffic from Bradley International Airport. The airport and its facilities are in good condition. However, in terms of its operation, expenditures currently exceed revenues.

Redevelopment of Brainard Airport as an industrial park is a potential project and is linked to the Riverfront Recapture Program and efforts to promote economic development by the Department of Planning in Hartford. An increased tax base for Hartford and increased employment opportunities are the prime objectives related to the conversion of the airport to industrial use.

An existing industrial complex, Brainard Industrial Park is located adjacent to the Brainard Airport which has an area of about 140 acres and approximately 69 businesses and public uses. Sales offices, supply and distribution centers and service providers comprise the majority of the companies located in the park. Transportation related facilities, including diesel truck repair, truck sales and truck rentals, are numerous. Very few businesses actually are involved in on-site manufacturing; most uses could be classified as commercial rather than industrial. The type of manufacturer found in the existing park are very small firms, employing relatively few people and located on sites or less than 2 acres.

E.5.3. Implications of Future Development

There are several implications of the changes from a primarily industrial to a post-industrial economy for this study. Quantities of bulky and heavy raw materials and finished products characteristic of industrial manufacturing are not characteristic of the major types of goods and materials now produced. Improved transportation systems such as rails and roads make the shipping of products quicker than traditional water transport. Container shipping makes the handling of many goods, especially those requiring one or more modal interchanges, an expedient method. The relatively high-value of the commodities often result in shippers favoring modes of transport that offer rapid transit times and, with just-in-time inventory systems gaining favor, transit time has become even more important.

Of additional interest, the Western Massachusetts Economic Study indicated that rental rates were well below the national average for industrial space in 1981. The cost in Massachusetts counties was about $2.50/square foot and in Hartford County about $4/square foot compared to an average of $10/square foot cost for 128 cities surveyed nationwide. The cost per acre of industrial land also was less than half that of the cities surveyed. These lower costs, combined with the availability of waterborne transportation through an extension of navigation on the Connecticut River, could help the region to retain existing manufacturing businesses or, potentially, to attract users dependent on water transport.

E.6 FUTURE DEVELOPMENT PLANS

A survey was performed by telephone and personal interviews to collect information about development plans within the study area that could impact the potential use of barge service on the Connecticut River. The survey involved 40 individuals from 38 different agencies. These groups included local and regional planning agencies, state government agencies, development corporations, economic development research firms, and real estate firms. A list of the agencies and persons interviewed is shown in Appendix F.

The primary focus of the survey was to determine if development plans existed that would result in the construction of facilities that would either consume or produce materials that would have a potential to use barge services. The survey findings are reported below within four subdivisions based upon geographic regions. These sub-groups appear to be somewhat homogeneous internally, particularly from the standpoints of development trends taking place. These are: Northern Hartford County and Tolland County, in Connecticut, Greater Springfield and surrounding communities, and Holyoke-Chicopee and surrounding communities.

E.6.1 Connecticut Communities

Although substantial development is taking place in Hartford County, most of those interviewed substantiated the finding reported in the Economic Baseline section of this report that the economy is shifting away from manufacturing toward the service sector. Development in Hartford County can be characterized as either spin-off developments that are directly related to the insurance industry that has established its core in Hartford; and construction of corporate office headquarters and the commensurate expansion of the real estate industry. Industrial development that is occurring is either for general commercial or light industries, primarily involving warehousing facilities. These types tend to be highway-oriented facilities that have selected locations along the Interstate 91 corridor. According to those surveyed, none of the new development taking place in Northern Hartford County would generate demand for barge services.

Despite the presence of navigation south of Hartford, only the petroleum industry has taken advantage of this transportation mode. According to the Connecticut Petroleum Council, no plans exist within the area for either the expansion of existing petroleum facilities or for the development of new terminals.

The Water Resources Unit of the Connecticut State Department of Environmental Protection is one agency that is responsible for issuing permits for development adjacent to the Connecticut River. According to this agency, development planned for land bordering the River is for commercial and recreational use. Based upon the plans of Hartford's Riverfront Recapture and the planned marina facility in East Hartford, it appears that waterfront property will not get encouragement for having industrial use. Industrial development is light in character, principally involving warehousing facilities located on sites afforded good highway access. For example, Griffin Center located between Windsor and Bloomfield, Connecticut includes approximately 600 acres involving primarily corporate office development and light industrial and warehousing facilities. Additionally, Hazelwood in East Granby, Connecticut, is also being developed for light industrial/warehousing uses. According to the real estate leasing agent from Culber Land Resources responsible for these industrial parks, those firms that do ship goods utilize truck transportation and sometimes rail transportation. No plans exist to market land for heavy industrial development, so it is the expectation of the leasing agent that none of the facilities will be involved in shipping raw materials or bulk commodities.

The Project Supervisor for North Meadows Business and Industrial Development Park, located along Interstate 91 north of Hartford, stated that industries in Hartford are generally not interested in river shipping due to poor access to the River. Interstate 91 and earth dikes form physical barriers to the River, making access difficult or impossible. For example, the North Meadows Project contains a 24 acre parcel that is being marketed for industrial development. However, it is located on the west side of Interstate 91 and has poor access to the river. It does, however, have good access to the highway.

A resource recovery plant in the South Meadows section of Hartford is being designed to process up to 2,000 tons of municipal solid wastes per day. By 1981, about 39 Connecticut towns had passed resolutions indicating interest in participating in the solid waste recovery system. The wastes will be collected with municipal garbage trucks and then transloaded to larger trucks for delivery to the plant. Coal may be shipped up the Connecticut River to a location in Hartford below the current head of navigation.

The development trends now occurring in Northern Hartford County appear to be also influencing the nature of development in Tolland County, located to the east. According to the Windham Regional Planning Agency, which includes Tolland County, the development taking place would not utilize barge services on the

Connecticut River. Educational and governmental institutions comprise the largest employers in the area. The agency estimates that only one job in seven is industrial. The most significant development now taking place in Tolland County is located in Mansfield where the University of Connecticut is building a research and development center. Based on the development occurring in Tolland County and the nature of the economy and employment base there, it cannot be expected that any number of potential barge shippers will be generated there.

E.6.2 Greater Springfield and Surrounding Communities

Like Hartford, a substantial amount of development is taking place in this area of Massachusetts. Based on the statements made by those surveyed, no current development plans exist that will result in potential users of barge services. However, opportunities for the creation of new development that may lead to potential barge users may be generated by the new industrial land resources being planned and developed in the Springfield area as a result of numerous economic development efforts. Despite this, according to those surveyed the land will be targeted to light industry for clean development. Furthermore, the sites now being planned or developed are already serviced by rail transportation, a factor which many believed would substantially dilute any demand or need for barge shipping unless, of course, the cost would make it advantageous.

Three industrial parks in Springfield are being developed that will eventually create approximately 230 acres of industrial land. Each of these parks has rail service. These parks are North Central Industrial Park (30 acres) located near downtown Springfield, the North End Industrial Park (150 acres) located in Chicopee and Springfield, and the privately-owned Carando Industrial Park (50 acres) located near the existing Memorial Industrial Park, a large industrial center with a concentration of distributors and manufacturers of food and paper goods. While no development plans exist for these parks, the potential for new development is substantial for the future.

Also similar to Hartford is the transition in the use of waterfront property from industrial to more commercial and recreational uses. Springfield Central is involved in the development and implementation of plans for downtown Springfield, including the waterfront. This planning and development organization plans to create commercial developments along the River that include hotels, moorings, and residential areas. The Western Massachusetts Development Corporation (WMDC) plans, markets, and manages

development of numerous industrial parks in the Pioneer Valley: e.g., seven parks in Springfield, and parks in Agawam, Palmer, East Longmeadow and West Springfield. WMDC stated that with the exception of Palmer, no industrial development plans exist for WMDC parks or for others in the Pioneer Valley that would result in potential uses of barge services.

The Palmer Industrial Park, located approximately 20 miles east of Springfield and the Connecticut River is near the Massachusetts Turnpike. It presently has seven potential user that are dependent upon rail freight. The Palmer Park is serviced by rail transportation, a feature making the park attractive to these industries. According to WMDC, the distance between Palmer and any port facility on the river would make barge transportation too expensive when rail service is provided on site.

In West Springfield, most new development is either for retail/commercial or hotel/motel. Most industrial park land has been developed. Only two sites remain, the largest involving 20 acres. However, no development plans exist for these sites. New industrial development taking place in West Springfield is very limited involving the expansion or development of machine-shop establishments.

East Longmeadow has over 200 acres of industrial zoned land available for development. Approximately 14 acres is included within a Western Massachusetts Development Corporation managed industrial park. Industrial development is apparently not moving forward and no plans exist for development.

Agawam has an industrial park, managed by WMDC, which, like other area parks is oriented toward light industrial development. According to WMDC and the Agawam Town Planner, no development is occurring that would lead to barge use. Other industrial development in Agawam, as in West Springfield, is very small.

E.6.3 Holyoke-Chicopee Communities

No new industrial development is planned for Holyoke. Only two industrial sites exist in Holyoke--both less than 20 acres in size. The primary economic development efforts in Holyoke are maintenance-oriented with the objective of retaining and supporting existing industry. The Canal District Plan, is targeted at improving the utilization of nine downtown industrial buildings.

The only major new development in Holyoke is a regional resource recovery facility owned and operated by the Holyoke Energy Resources Company. According to the manager and owner of this facility, if barge transportation services were available,

he would not be interested in utilizing its service. However, the owner stated that if barge services were available, he would consider other business ventures that would utilize barge shipping.

In Chicopee, more opportunities exist for industrial development; however, those surveyed stated that no development plans exist that would generate potential barge use. There are three industrial parks in Chicopee: a portion of the North End Industrial Park, which extends into Springfield, the Westover Air Park Development which reaches into Ludlow, and the Chicopee River Technical Industrial Park. The North End Industrial Park which will involve a total of 150 acres is located principally in Springfield. According to Chicopee's Community Development Director, this Park should not be considered a major factor in Chicopee's industrial land portfolio as sewer separation problems exist which will limit its potential. The Chicopee River Technical Industrial Park is primarily oriented toward office development, but 25 percent of the space is directed at research and development uses and another 25 percent is for light industry. No plans exist for this park that could be expected to generate barge use.

Ampad Industries, a paper products manufacturer located in Holyoke, is developing an industrial park in Westfield to locate another plant. The park, which will eventually involve approximately 150 acres, will have land available to other industrial developers. At this time, only Ampad has firm plans for development in the park. Paper is currently shipped to Ampad in Holyoke by rail. This would also be the case for the Westfield plant, although freight shipping decisions are made bay the paper manufacturer, not Ampad. For outbound shipments Ampad currently utilizes truck and some rail transportation. Barge transportation is not feasible due to the small lot sizes and wide range of destinations. According to Westfield's Community Development Director, Ampad's is the only planned industrial development in Westfield that could conceivably consider using barge shipping.

Finally, the Westover Air Park Development is managed and marketed by the Westover Metropolitan Development Corporation (WMDC). According to WMDC, aviation-oriented industries are targeted in their marketing efforts. Prerequisiteś exist for development in the park: the development must be labor intensive and the development must be non-speculative. Although aviation-oriented industries are being targeted in WMDC's marketing efforts, water transportation-oriented commodity producing/consuming would not be prohibited from developing at the park as long as the prerequisites were met. Although no such development plans exist for Westover, the potential for development in the Park is substantial given the almost 96 acres now serviceable and marketable and additional acreage available for the future.

E.6.4 Development in General

Based on this information, it is clear that planned industrial development in the study area is not of the nature which would encourage development of barge services. Development of the types of heavy industry that would find economic advantages in the large volumes and low cost of barge service are not planned for this region.

Another factor which plays an influential role is a change in attitudes about the use of waterfront property resulting in a transition of land uses from industrial development to more pleasure-oriented and environmentally protected uses. This transition can be said to present a substantial deterrent to the location of industrial development along the river, thus making the river less accessible for transportation.